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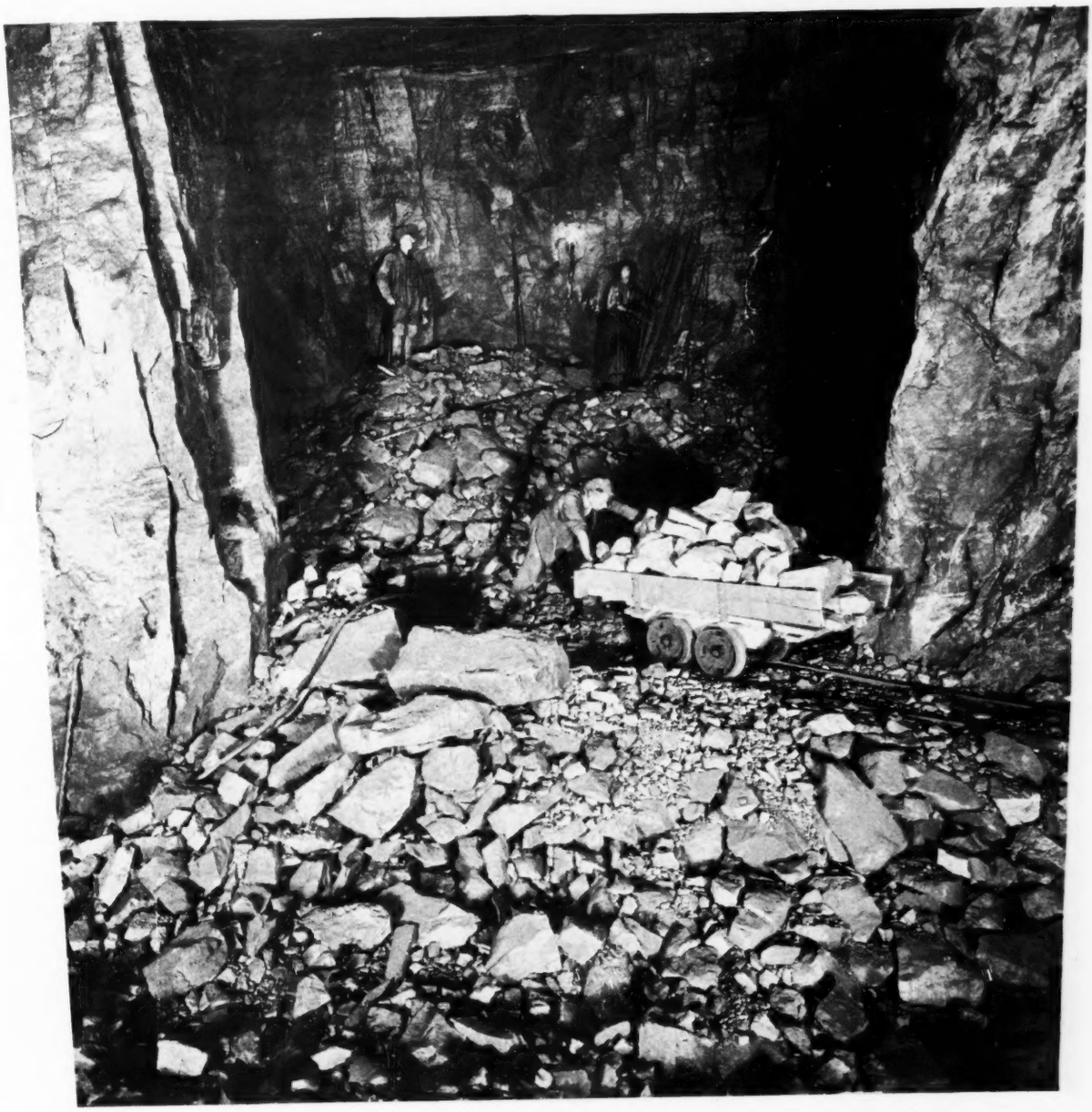

A TRIBUTE TO GERMAN MINING AND METALLURGICAL ENTERPRISE

AUGUST 24, 1931

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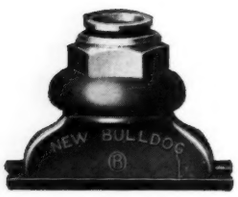

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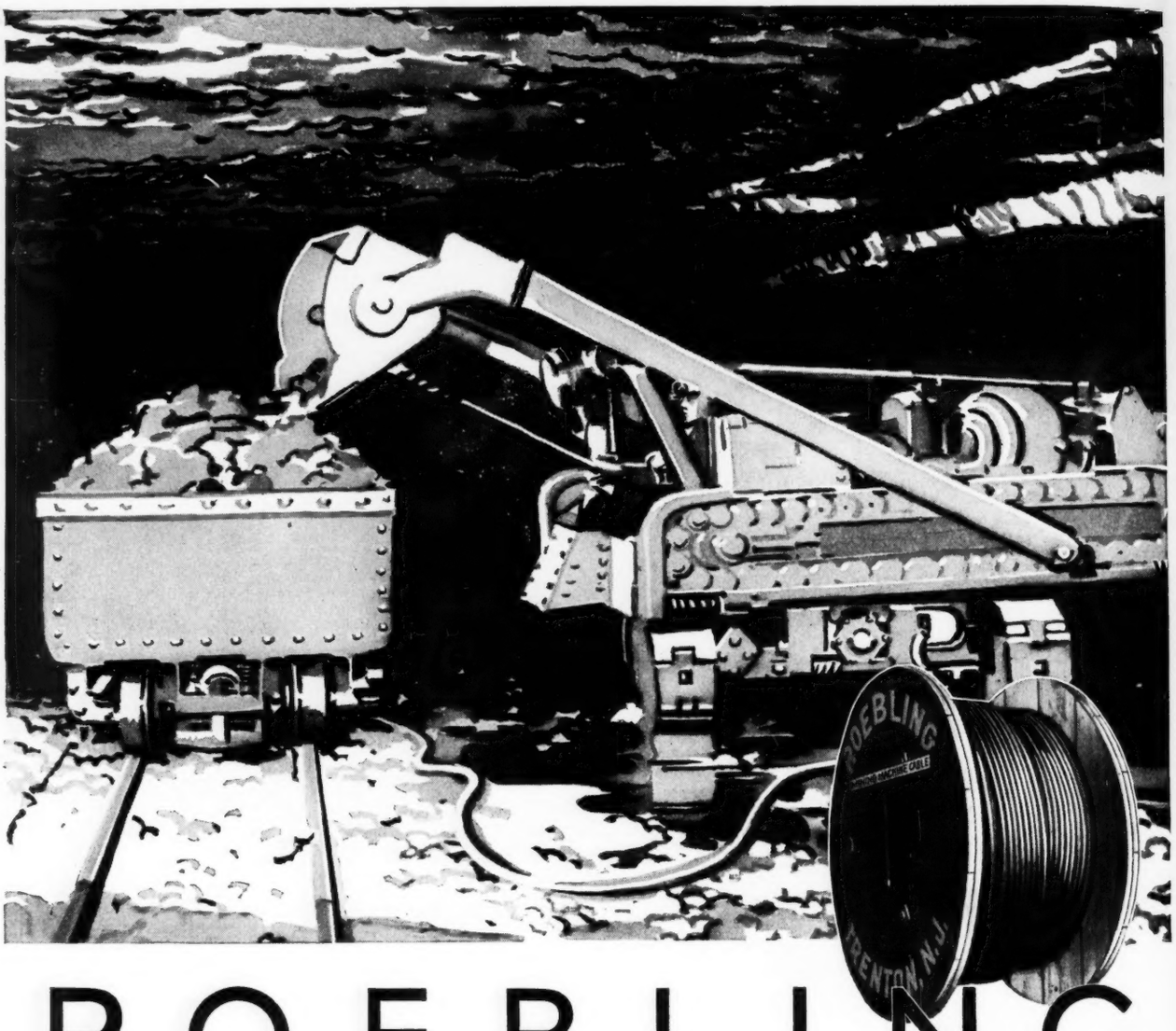

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Engineering and Mining Journal

August 24, 1931 A. W. ALLEN, *Editor* Vol. 132—No. 4

Mining and Metallurgical Progress in Germany

INTERNATIONAL EVENTS of recent weeks have served to focus on Germany the thought and interest and concern of the remainder of the world, and this publication welcomes an opportunity to pay tribute to the splendid persistence of her leaders, to the many evidences of executive ability, scientific spirit, indomitable perseverance, and technical skill that characterize the progress of her mining and metallurgical industries. The articles in the following pages of this issue, translated from the German by Mr. Birger H. Strom, assistant editor, provide gratifying proof of the generous and progressive attitude that actuates the engineers and business leaders of Germany, as evidenced by a willingness to share valuable experience and knowledge with their confrères on the Continent and overseas.

Technical progress and the interchange of engineering data, like scientific advance, know neither politics nor international barrier. The information now released on the history and present status of the mining and metallurgical industries of Germany is impressive in its tacit emphasis on the value of intellectual honesty and the courage to face criticism; in recognizing the importance of frankness and the cooperative spirit in the earning of a place of high esteem among the technicians and industrialists of the world.

The Restaurant Owner Goes Out To Dine

ARIZONA is considering or has adopted automobile license plates of solid copper, as a substitute for the enameled-iron plates heretofore used in all states. The object is to advertise the state's chief product, rather than to secure a plate of better wearing qualities; for the ordinary enameled plate, if given reasonable care, is still in good condition at the end of a year, when it is scrapped. The copper plates would be somewhat more expensive, but would have salvage value after serving their primary purpose. A few years ago Arizona adopted copper-colored plates, but the foundation metal was iron.

In general, mining companies overlook the value of advertising. Few spend one extra penny to add to the consumption of the metal they produce. The New Jersey Zinc Company is a notable exception, its head office, in New York, being liberally provided with zinc fittings wherever their use is feasible. Little copper, brass, or bronze is seen in the offices of the prominent copper companies. Most of the metal is steel, and even that is painted to imitate mahogany. And at the plant the purchasing agent usually considers the product of his own company a luxury metal—all right for the company's customers, but not for the home folks' use.

Opportunity exists for every mining company, in its own establishments, to develop new uses for its products, and to impress visitors with its own confidence in the value of the metal it is producing. The general office of a copper company can at least have a copper roof and brass hardware. And perhaps some company, some time, will incase one of its 500-foot smelter stacks with sheet copper, zinc, aluminum, or nickel. What a landmark that would make!

Society of Chemical Industry Celebrates Its Jubilee

A SPECIAL ISSUE of the *Journal* of the Society of Chemical Industry reminds one that it was founded in 1881. The jubilee celebration number is an interesting and instructive volume, indicating that advantage is occasionally gained by looking backward, if only to discover the reason for technical trends and to enable one to dwell for a while among those who have been mainly responsible for the major innovations that have stimulated so much secondary research and invention during the past half-century.

Compliment is due to the editorial and typographical staffs of the *Journal* for a volume that does credit to the Society and to its active sections, particularly in the Americas. Biographies of past presidents and other high officials provide interesting personal data, followed by reprints of outstanding papers published by the Society since its inception—twenty-one in all. Two of these are of especial interest to metallurgists. One, by John Stewart MacArthur, read at a meeting in Glasgow on March 4, 1880, outlines the cyanide process of gold extraction, concluding with the pioneer's prophecy, since abundantly fulfilled, that "cyanide of potassium, hitherto used only to polish amalgamated plates, will take a front rank as chief agent in gold extraction." The second paper to be reprinted in this interesting volume, by Oliver Lodge, was entitled "The Electrical Deposition of Dust and Smoke, with Special Reference to the Collection of Metallic Fume and to a Possible Purification of the Atmosphere." It was read at a meeting of the Liverpool section on November 3, 1886, and describes researches originally made by Lodge's sons, and subsequently carried on in cooperation with Dr. F. G. Cottrell, whose work

on the subject has been put to good use in every part of the world where modern metallurgy is practiced.

The time is opportune to congratulate the Society of Chemical Industry for its fine record of achievement in sponsoring the work of so many eminent scientists, and in providing for an interchange of knowledge. May its centenary celebration give additional proof of continued influence in the encouragement of research and in the application of science to the technical industries.

Ore Uniformity and the Flotation Process

ONE of the less obvious factors influencing the success of flotation is uniformity in the chemical nature of the ore. A regular rate of feed is essential to success, as is also an ability to control dilution and reagent supply. But sudden changes in the chemical nature of an ore complicate the problem, and high metallurgical loss may occur before adjustment can be made. A time element is involved. Particularly in some recent applications of flotation to the treatment of gold ores is this factor forcing itself to the attention of operators.

Uniformity of ore composition is possible by systematically drawing from several chutes and stopes, and distributing the ore over the length of the bin so far as practicable. This can be accomplished satisfactorily if belt conveyors and trippers are in use. Cars used to transfer ore from the crusher bin to the mill bin should not be dumped at one point. Effort should be made to secure a blending effect. Considerable lack of uniformity may require systematic bedding—the last recourse after other less complicated methods have failed.

Almost all continuous metallurgical processes demand uniform ore composition. Every effort to secure this uniformity should be made by designers of milling and flotation plants.

Simplification and Standardization May Begin at Home

DISINCLINATION to effect a change of policy, of obvious advantage, sometimes arises from a realization of the natural conservatism of people. A logical calendar cannot be expected to elicit widespread acceptance within a few short years or even decades, but that offers no reason why the independence of individual companies and organizations should not assert itself. Mr. R. H. Matthiessen, in the current issue of the *Executives Service Bulletin*, describes how his corporation, the Western Clock Company, with a personnel of two thousand, has used a calendar of thirteen months per year since 1892. The system applies to all company operations excepting contact with the trade and the public.

The Westclox calendar provides for four full weeks of seven days each per month. The thirteen-month year, therefore, accounts for 364 days, the extra day being carried forward until seven of them have accumulated, when a July month of five weeks is arranged —the only variation from regularity, occurring once every five or six years.

The general public will perhaps be surprised to learn that the thirteen-month calendar has been adopted in over one hundred industries in the United States, indicating a growing realization of the advantages of the system, which Mr. Matthiessen summarizes as follows: (1) All months of an equal time length; (2) standardization and equalization of budget periods, facilitating operations; (3) all reports are immediately available for comparative purposes, without reconciliation; (4) uniform payroll by simplified methods; (5) a definitely beneficial psychological effect on employees; (6) closing periods always end with the week, whereby a full week may be allowed for completing reports; (7) avoidance of the time element from analyses made to determine cause for variations in total monthly performance and results.

Experience is the best teacher. Proof of the wisdom of abandoning the old Gregorian calendar is seen in the enthusiasm of those who have had the courage to rise above precedent and custom and to adopt a system more in harmony with the industrial and scientific spirit of the times.

Good Ideas Need Commercial Exploitation

PROFESSOR WILDER D. BANCROFT, of Cornell, recently discussed the world's treatment of "good ideas," the failure of acceptance of so many of which is sometimes explained by the inference that the world was not ripe for them. Let us ripen the time, urges the professor. To do so, one must discover something for which the world is ready; one must educate the world in the importance of the discovery. In many instances, we are told, the man who evolves the idea is not in a position to secure its acceptance, and this task falls to the lot of one who may be less clever, but who speaks a language that makes the world conscious of the value of the treasure being offered to it.

A search would have to go back many years to discover who was the first mechanic or engineer to suggest that the tension on a driving belt could be automatically maintained by allowing the weight of the motor or machine to supply the necessary uniform force. To mount the motor on a base that was attached by means of hinges to the foundation probably formed the initial application of the idea, an idea that may have come to many inventors simultaneously; a man is no less an inventor because others have evolved the same idea. But in this particular instance the absence of organized promotion of the invention limited its use to negligible proportions, with makeshift, home-made apparatus, despite the fact that the innovation constituted an invention based on sound principles, simple in mechanical application, involving no maintenance problem, of certain profit and advantage.

Recently the idea of a hinged motor base has been adopted and developed and standardized by one of the leading engineering corporations, which is preparing to

sell the auxiliary equipment that will permit the idea to be put into practice efficiently. Modern publicity methods will carry the message of perpetually uniform belt tension to the operator of every motor drive. The public will be educated. The sponsors—by experimentation, trial and discard, the analysis of result, control of long-term tests—will possess convincing data. The result is a foregone conclusion.

Some of the best ideas ever evolved have died a-borning, for lack of engineered publicity and the means to combat the opposition of those sceptics who invariably scorn pioneer work in any field. The industrial plant and the home will always need new inventions; but tremendous opportunity exists to ignore the envy and malice and apathy that have killed so many excellent ideas, to resurrect them, analyze them honestly and fairly, and give them a trial under conditions planned to encourage success.

Scope and Encouragement for Inventive Initiative

NARROW CHANNELS, near and leading to the sea, cause an exaggerated tidal effect. Opportunity for the cheap production of power is seen in such a locale. As far back as 1843 a plan was proposed to harness the energy going to waste thus in the Bristol Channel. Several attempts have been made, which culminated recently in the erection and operation of a successful pilot plant, with a capacity of about three hundred horsepower. The main problem has been to equalize power output over the complete cycle of low and high tides. To pump a part of the high-tide flow to a greater elevation is practicable but uneconomic. As an alternative, the new plant, designed by Mr. Paul Shishkoff, is provided with an accumulator, in which is stored, under pressure, water that has been previously heated by being churned. When a decline occurs in the tidal power, the pressure on the accumulator is released, and steam is formed. A turbo-generator unit converts this into electric power, which complements the output of a waterwheel-generator unit that operates during the tidal-outflow period.

The scope of application of any plan to harness the tides is extremely limited; and the new development in England is not discussed as indicating an important source of power, but as a tribute to an inventive ingenuity that seeks to overcome obstacles of a mechanical nature, when such obstacles, as judged by fundamental laws and engineering experience on the behavior of force and matter, are not obviously insuperable. Two other obstacles may have to be reckoned with, however. The inventor must secure adequate financial assistance, and he must usually overcome an opposition that is the outcome of unscientific skepticism and personal jealousy.

A combination of poverty and inventiveness invites injustice, to avoid the hazard of which the inventor must blend with his constructive inquisitiveness a strain of aggressive commercialism. If he is not made that way, he may find comfort and compensation in the fact that, though intellectual dishonesty and unjustified doubt may combine to deny him opportunity or credit or reward, no one can steal from him the sharpness of mentality and the urge to explore that are induced by systematized inventive effort.

Solving the Industrial Dispute Problem

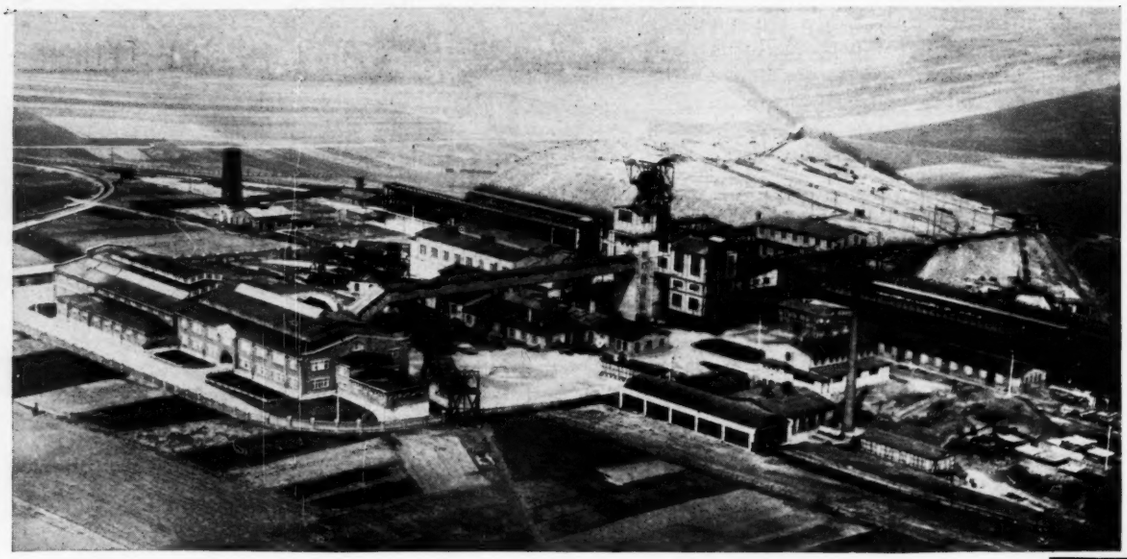
EMPLOYEES are not unreasonable in demanding fair pay and short hours of labor, but employers are equally within their rights in an insistance on quality and quantity output—on care and zeal. Loyalty must be forthcoming from both sides. Interests and aims of employer and employee are interdependent and complementary. The single aim of industrial effort as a whole—national prosperity—should be recognized. Any deep-seated spirit of antagonism between labor and capital must be overcome, even if it be necessary to enable every laborer to become a capitalist. Each party should realize that harmony and progress depend on the development of a truly cooperative spirit.

A study of conditions in 1928 indicated that the principal nations of the world were then entering on a new era of industrial relations, with Australia as the sole exception. There, economic conditions for many years had been adversely affected and progress had been retarded by a labor movement lacking evidence of the larger idealism. At that time this publication concluded that mining in Australia could not be expected to revive until an improvement in industrial relations was effected, following a readjustment of opinion and conditions. A contempt for the opposite viewpoint always makes adjustment of differences exceedingly difficult; and in this respect both sides were to blame, with an apparent lack of appreciation of the success of contemporary methods of alleviation and conciliation as a contributing cause.

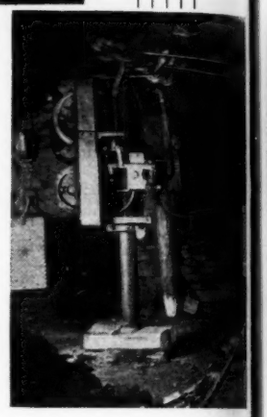
Recently we were privileged to publish an inspiring account, written by Mr. Charles A. Mitke, of what has been accomplished at Mount Isa, Queensland, in recent years by the application of the highest principles of human engineering. The results dispose of the contention that the Australian workman is less reasonable than his fellows elsewhere—if an approach is made in the right spirit, in sincerity of purpose, for the good of the enterprise, of the community, of the state.

No less credit is due to Mr. Mitke because his interest in the men and his concern for their contentment and that of their families resulted in mine-performance records that deserve the highest commendation. With strained industrial relations, such as obtain in so many Australian mining communities, no progress could have been made at Mount Isa; but one incident illustrates what Mr. Mitke and his staff did to change the attitude of labor: At a club meeting late in 1930, at which 300 miners were present, a team was introduced that had made a record for all Australia—469 feet in a 9 by 9 foot heading in one month. These champions were cheered to the echo by their fellow workers, who took pride in the accomplishment, and found the action brought more satisfaction than would result if they continued to heed agitators who for many years had reminded them that "the cemetery is full of record breakers."

Mount Isa has proved the practicability and the value of mutual respect between employer and employee. Australia in the past has been accustomed to achieve industrial peace by the collapse of one of the parties to a settlement. The new dispensation will give greater opportunity to the many distinguished engineers and technicians and capable craftsmen that together form so important a part of the resources of the Commonwealth.



Aerial view showing Wolf shaft, the largest of the three Mansfeld shafts, with sorting plant, shops, and waste dump in background



MINING AND SMELTING AT MANSFELD

DIRECTOR EMIL SCHRÖDTER

With a venerable past, stretching back to the Middle Ages, the Mansfeld enterprise is now the largest German producer of copper and silver from native ores. Efficient utilization of byproducts and coordinated fabricating activities offer evidence of the progress of a historic corporation.

IN THE heart of Germany, in the southeastern foothills of the Harz Mountains, about 40 km. from the old salt city Halle a.S.—the present nucleus of central Germany's lignite industry—is a buried treasure which supplied almost all Europe with copper up to the end of medieval times. Darkness still shrouds the early operations of the Mansfeld copper shale mines, which, even today, with an annual production of 24,000 metric tons of copper and 125 tons of silver, rank among the first in Europe. Judging from old documents, the first mining activities date back to the second half of the twelfth century, although the first authentic record is dated 1223. About a century and a half later, in 1364, the operation of the mine became linked with the history of the Count of Mansfeld, who that year received the property as a fief.

Of great importance to the Mansfeld plant was the "saiger" process (sweating process) of the black copper, developed in the second half of the fifteenth century. This process—recovery of silver from the black copper by addition of lead—was one of the most important developments in the history of the plant, greatly affecting production and profits. During this time, however, the Count of Mansfeld experienced financial difficulties, and in 1570 his lieges, the Archbishop of Magdeburg and the Elector of Saxony, took the opportunity to seize the mines, which then came under the direction of the Elector. During the Thirty-year War, all mining activities ceased, and the recovery from this difficult period was slow. Not until 1671, when more freedom was granted the mining industry, did improvements take place, but production was still on a comparatively modest scale—about 750 tons of copper annually for the best years up to the end of the eighteenth century, when a gradual decline took place, and in 1770 the production was only 400 tons.

Meanwhile, many independent companies were operating. For technical and economical reasons these were gradually consolidated into five concerns. When the Vienna Congress awarded Mansfeld to Prussia, they were placed under the supervision of the Prussian mine office at Eisleben. In 1852 they were finally united under the name "Mansfeldsche Kupferschiefer bauende Gewerkschaft." About the same time the existing method of management was abandoned; and free, unrestrained development was made possible. With the new leadership, radical changes were made. Large shafts were sunk, efficient pumping plants installed, and great smelters built.

After the World War the old form of management proved inadequate for the growing activities of the concern, especially in view of the difficult economic conditions of the post-war period. In 1921 all interests of the old concern were consolidated in the new Mansfeld A.G. für Bergbau u. Hüttenbetrieb, in Eisleben, with a capital of 37,875,000 marks. A reorganization of activities was also effected. Plants were modernized and mechanized, modern shafts were sunk, and old smelters rebuilt. The copper and brass plant at Hettstedt was also modernized.

A steady increase in the tonnage of ore mined has taken place since 1920, when 527,000 tons was mined, to 1930, when the production was 810,000 tons. A total of 7,700 men are engaged in mining copper shale alone. Hoisting is done in three shafts, of which the Wolf and the Vitzthum shafts rank among the largest and best equipped in Europe, whereas the older Clotilde shaft is of secondary importance. In the Wolf-shaft section about 4,000 men are employed. This shaft became the main hoisting shaft in 1923. Two extensive electric haulage systems unite in this shaft on the seventh level at a depth of 557 m., the central point for the main part of the underground hauling from the southern section of the deposit. The workings are extensive, as the mining of a vein only 20 to 25 cm. (8 to 10 in.) thick progresses rapidly. Until recently all mining was done with pickaxes. At present, pneumatic tools are used everywhere — pick hammers and hammer drills, for breaking the copper shale and the waste rock in the hanging wall.

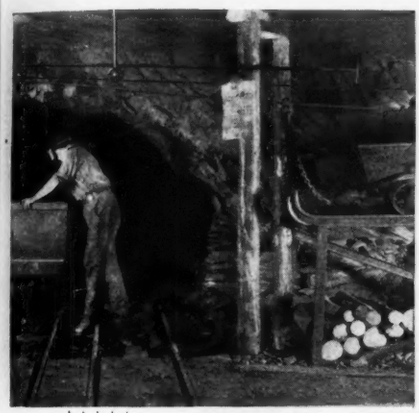
The broken ore is loaded with shaking conveyors and electric scraper hoists; loaded cars are gathered and run by gravity to the main haulage level. Modern electric mine locomotives are used for hauling the cars to the shaft.

In the Vitzthum-shaft section, where about 2,500 men are employed, two large electric haulage systems are in use, one on No. 7 level (593 m.), the other on No. 9 level (719 m.). Mining in this section, which has progressed toward greater depth, takes place mainly between levels 7 and 9. Levels 10 and 11 are being developed at the present time. In the Clotilde section a steam-driven haulage system is in use.

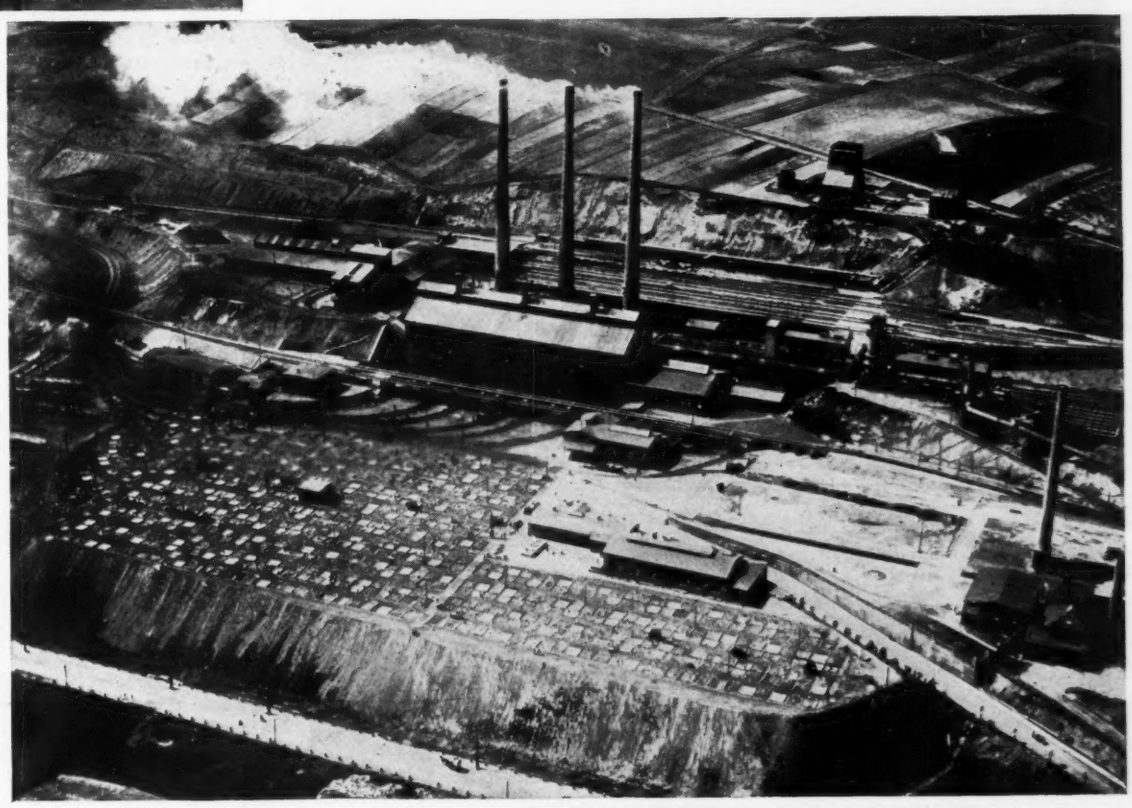
The ore is hand-sorted on the surface and then transported to the two smelters, the Krug smelter, at Eisleben, and the Koch smelter, at Helbra. A narrow-gage railroad, operated by the company, with a total trackage of about 100 km., provides transportation facilities between the different units.

The ore (locally called Minern) containing 2.5 to 2.8 per cent copper, is again sorted at the smelters, and the fine material is either briquetted or sintered on Dwight & Lloyd machines. Smelting is done in large blast furnaces, producing a raw matte with 40 to 45 per cent copper. Three large water-jacket furnaces are used at the Krug smelter, each having a daily capacity of 650 tons of ore. At the Koch smelter, nine smaller 160-ton furnaces are used. These are cooled by water spray. The charge contains 16 to 18 per cent coke, and limestone in varying amounts.

Three valuable byproducts are made —flue dust, furnace gas, and slag. In addition to sulphur the flue dust contains mainly lead, zinc, and heavy oil. It is treated in the smelter at Hettstedt for recovery of lead. Zinc, slagged in the lead furnaces, is recovered as oxide by the Waelz process. The flue gas is cleaned thoroughly and then piped to the power plants at both smelters and burned under specially constructed boilers. A total of 75 million kilowatt-hours is produced yearly from the furnace gases,



Terminal of electrically operated car-haul in section of mine served by Clotilde shaft



Krug copper smelter at Eisleben, with slag dump in foreground

in addition to 35 million kilowatt-hours from coal-fired boilers. Practically all of this power is used by the Mansfeld plants. A third electric power plant, at Hettstedt, serves as a reserve.

The third byproduct, which is gaining increasing importance, is the slag, which has the peculiar characteristic of solidifying into a fine-crystal stone, when cooled in a certain manner. This stone, which possesses great hardness, toughness, and excellent texture, has been found to be a fine material for street paving. For streets with heavy traffic a large paving stone, 16x16 cm., is produced. Lately, a smaller stone is also being produced, which is used for streets where the traffic is less heavy. This stone is 9x9 cm., or 9.5x9.5 cm. In 1920 a record production of 30 million stones, or 296,000 tons, was attained.

Raw matte from the two smelters is treated in the converter plant at Hettstedt. It is first melted down in cupola furnaces and then blown in converters, either to a high-grade matte ("Spur" matte) with 70 per cent copper, or a blister with 98 per cent copper. About two-thirds of the total production is blown to high-grade matte and then worked into copper, which is marketed under the trademark M.R.A.—a tough grade of copper, containing some nickel. In this process the high-grade matte is first ground and then desilverized in the silver plant by the so-called Ziervogel process—a roasting and leaching process peculiar to the Mansfeld operation. The desilverized matte is returned to the copper smelter.

A third of the production, which is blown to blister copper, is cast into anodes and refined by electrolysis. The anode slime is treated in the silver plant, where also small amounts of gold and platinum metals are recovered.

Gases from the blast furnaces and the converters are cooled and treated in Cottrell precipitators. They are then delivered to a modern sulphuric acid plant of the Petersen type, annual capacity 40,000 tons acid of 60 deg. Bé.

A special organization with office in Berlin handles all sales of metals, and the Montangesellschaft m.b.H., a subsidiary of the Mansfeld organization, has charge of ore buying. The company is a member of Copper Exporters, Inc., New York, and is represented in that organization by its agent in New York, Tuthill & Company, Inc.

Production, power consumption, men employed, and other information are given in the accompanying table. A two months' strike in 1930 caused a drop in most figures for that year.

	1928	1929	1930
Ore produced, metric tons	829,000	939,100	808,760
Copper produced (not including customs work) tons	21,225	22,893	21,108
Fine silver, kg.	112,845	123,370	109,297
Soft lead, tons	2,400	2,535	2,210
Zinc oxide, tons	7,056	7,740	7,315
Zinc sulphate, tons	698	1,480	1,924
Sulphuric acid, tons	38,353	39,335	38,464
Paving stones, milles	27,700	30,600	17,800
Coal (not incl. Sachsen mine) tons	629,682	679,987	531,247
Coke (not incl. Sachsen mine) tons	240,598	245,890	186,313
Lignite, tons	2,198,903	2,247,055	1,919,420
Lignite briquets, tons	670,020	747,525	611,250
Sodium chloride, tons	7,272	2,554	2,232
Tile products, milles	19,542	15,827	12,055
Power produced, millions kw.-hrs.	102.7	108.8	97.7
Employees at end of year	20,186	20,863	17,460
Total wages, thousand marks	43,225	48,487	38,146
Expenses for welfare work, thousand marks	7,365	7,693	6,747

At an early stage the Mansfeld company added fabrication of metals to its activities. A plant in Düsseldorf manufactures silver tableware and instruments. A large and modern copper and brass plant in Hettstedt produces wire, cable, sheets, strip, tubes, rod, plates, and similar articles in copper, red and yellow brass, bronze, and german silver. This plant normally employs 2,000 men.

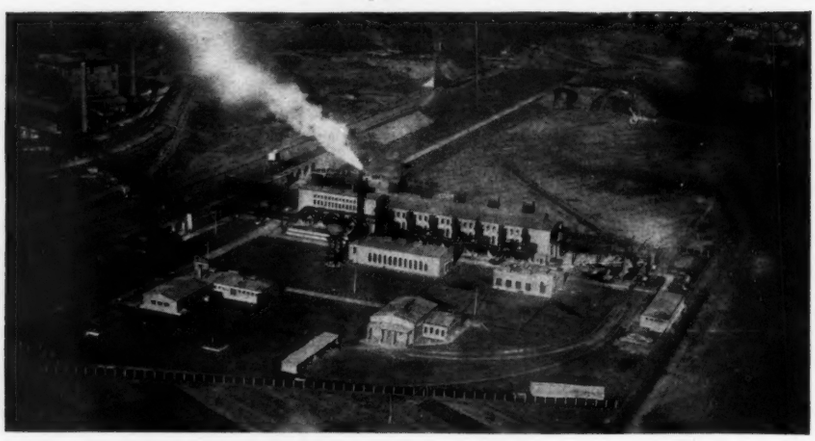
In addition to regular metallurgical operations, the Mansfeld company also operates a machine factory and a clay plant and pottery. The main office is still in the old mining town of Eisleben.

To insure a regular supply of coal and coke, the company many years ago acquired the Mansfeld mine at Langendreer, in Westphalia. This mine, with five shafts, was completely modernized after the War. In addition, the company has a half interest in the Sachsen mine, at Heessen, near Hamm, in Westphalia, which was opened a short time before the War, and today is looked upon as the model mine of the Rhenish-Westphalian coal fields. Both mines, employing 3,500 men, have a regular annual production of 1,300,000 tons.

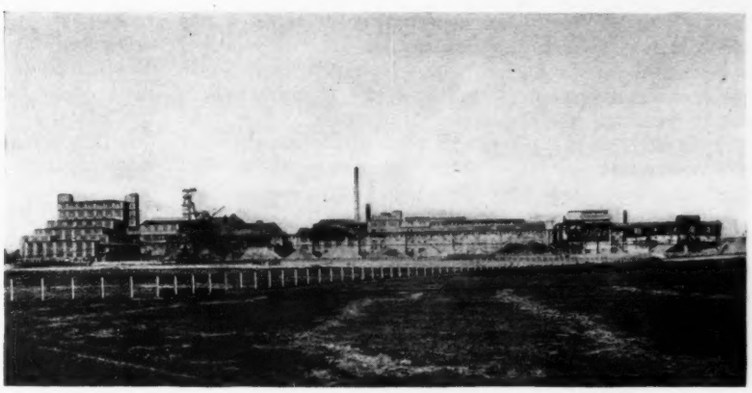
In addition to an adequate coal supply, Mansfeld, in acquiring the Pfännerschaft, at Halle, is also assured of an ample supply of lignite and briquets. This concern operates the famous salt mine at Halle, where rock salt has been mined for centuries, and two large lignite mines, capable of producing 2,250,000 tons per year.

Although the relative importance of the Mansfeld plant on the world's copper and silver market has decreased in later years, it still remains the only German concern producing large tonnages of copper and silver from domestic ores. Today it is one of the leaders in the German metal industry.

Converter plant at Hettstedt, treating copper matte from the Krug and Koch smelters



Gottesbelohnungs smelter at Hettstedt at right, with copper and brass mills in background



General view of plant, showing headframe, zinc and lead concentrator, and the Waelz plant

GIESCHE'S ERBEN ENTERPRISE

DIPL. ING. FRITZ LAKWEY

At Beuthen, in Upper Silesia, the German Bleischarley lead-zinc mine and the Heinitz coal mine are operated by Giesche's Erben, with a historical record of nearly two centuries. Lead and zinc concentrates are shipped to Polish smelters, but plans are complete for a reduction plant on German territory, probably in Magdeburg.

THE history of the George Giesche's Erben (George Giesche's Heirs) mining company goes back to the year 1704, when Emperor Leopold I of Austria granted to George Giesche, merchant, a lease to mine calamine ore. After the death of the lessee the lease was transferred to his estate, and a mining company was formed, which in 1860 received its present rights by royal decree.

Extremely rapid development of the mine and smelter during the second half of the ninteenth century made the enterprise one of the most important zinc producers in Europe. The division of Upper Silesia, in 1921, resulted in the transfer of four-fifths of the property, including all the smelters, to Poland. Only a part of the zinc-lead deposits remained on German territory, where later the German Bleischarley mine was opened. Of the coal properties, only the Heinitz mine was retained by the original owners. Financial difficulties caused by this division resulted in 1926 in the absorbtion of the Polish section, which had been organized into a separate concern, by Silesian American Corporation. In this organization, Giesche controls 49 per cent of the stock.

The property, east of the city of Beuthen, in the eastern part of German Upper Silesia, includes deposits of lead, zinc, and coal. A north-south section shows how the productive coal beds are overlaid by sandstone (Buntsandstein) and limestone (Muschelkalk), the latter carrying the lead and zinc ores. The ore is found above a footwall rock of non-dolomitic, wavy-banded limestone (Wellenkalk), and in the lower layers of the overlying, partly mineralized dolomite. Averaging 4 m. thick, it carries mainly zinc blende, galena, and pyrites, with oxidation products such as calamine and cerussite, of secondary importance. At 80- to 90-m. depth the deposit flattens out, dipping slightly to the north. In addition to this highly mineralized zone at the base of the dolomite, an upper zone of mineralization, mainly calamine and galena, occurs sporadically in a level 15 m. above. Of the productive coal formations the company has developed the Rudaer, the Ostrauer, and the Sattelflöz beds, the last mentioned being the most important. Combined thickness of all workable coal beds, down to 800 m., is 25 to 30 m.

As stated in the foregoing, the division of Upper Silesia left only part of the old Bleischarley mine in Germany. All shafts and surface plants became Polish territory, and a new shaft had to be sunk on the German side of the frontier. This work was started in January, 1925, and full production was attained in May, 1926. From this shaft, which reaches a depth of 90 m., a system of crosscuts has been laid out. In the southern part of the deposit these crosscuts run about 15 m. below the orebody, in the footwall rock. In the slightly dipping northern section they intersect the orebody. The crosscut system proper includes only the most important of the main haulageways. Other haulageways cut through the orebody. In addition to the hoisting shaft, two auxiliary shafts for ventilating purposes have been sunk. A pillar method of mining is used, which involves practically no loss of ore. The dolomite in the hanging wall is easily supported and generally caves in large blocks after removal of several pillars.

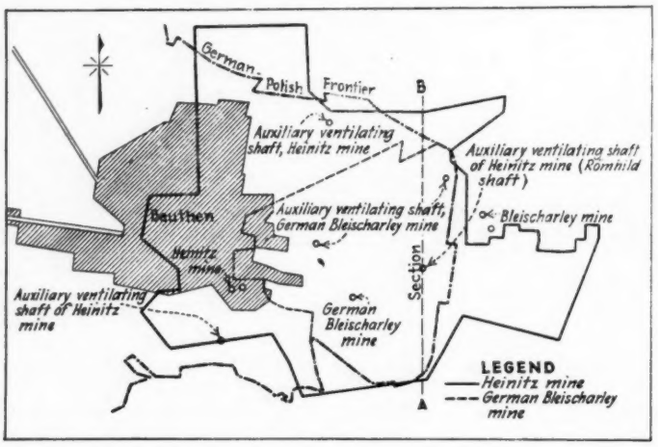
Compressed-air rock drills are used. Bulldozing is done with jack hammers. All loading is by hand, as mechanical loading is not economical with the mining method used, which permits the breaking of only 15 tons of ore in each

stope at a blast. The nature of the hanging wall precludes changes in the mining method.

To increase output, particularly by preventing the mining of barren rock, many of the stopes have been equipped with electric light. Whenever possible, the light circuit is connected directly to the electric haulage system. Where this cannot be done, compressed-air-driven electric generators supply the power. In crosscuts as well as in the main haulageways, mine cars of 1.1 tons' capacity are drawn by 18-hp. electric locomotives. Hand tramming is used only to a small extent. The two grades of ore produced are kept separate, to simplify operations in the concentrating plant. A 120-hp. electric hoist is used.

Concentration of the blende-calamine ore is difficult because it contains 12 to 16 per cent pyrite. In spite of this fact, jig concentrates are the principal products; the buyers, the Polish smelters, are equipped to treat only a small quantity of flotation concentrate. To produce a concentrate with 47 per cent zinc, large amounts of pyrite must be removed. This pyrite naturally is heavily contaminated with zinc. A flotation plant for pyrite, the first in its kind in the district, has been built to recover a high-grade zinc concentrate and a pyrite concentrate.

A radical change will be made in the flowsheet of the concentration plant when the company's projected reduction plant is operating. Flotation concentrates will be treated in the local plant, and a small tonnage of jig concentrate will be sold to outside smelters. Special attention will then be given to the treatment of the intermediate products containing the pyrite, to obtain a concentrate with at least 61 per cent zinc.

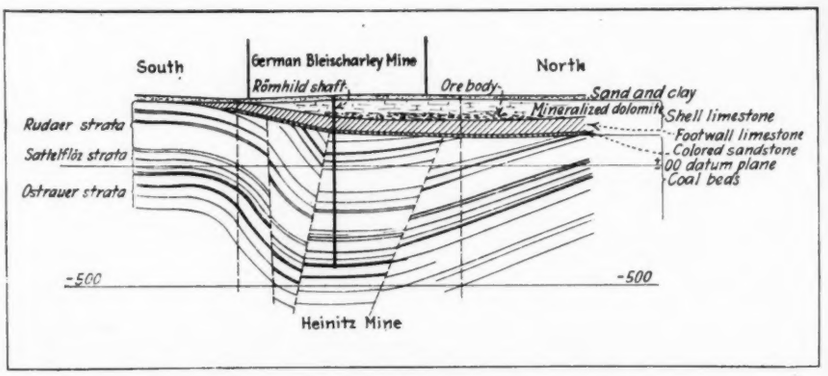


Map of Bleischarley lead and zinc mine and Heinitz coal mine, near the city of Beuthen, Upper Silesia. Scale 1:25,000

▼

A zinc blende-galena ore, with about 23 per cent zinc and 3.5 per cent lead, and a galena-calamine ore, with 17 per cent zinc and 6 per cent lead, are produced. The concentration process used is shown in the accompanying flowsheet. Blende-galena ore is treated in a concentrator with a capacity of 1,000 tons per sixteen hours. Stone breakers, rolls, and ball mills are used for crushing and grinding, and trommel screens for classification. Down to 5 mm. size, Rastex screen cloth is used; below 5 mm., bronze cloth. A vibrating screen is also used for certain operations. Material between $\frac{3}{4}$ and 17 mm. is treated in 55 five-cell jigs, producing lead and zinc concentrates and intermediate products. Material below $\frac{3}{4}$ mm., after treatment in two thickeners—one of 15 m., the other of 17 m. diameter—is sent to a flotation plant having a capacity of 250 tons per 24 hours. Overflow from the thickeners, amounting to 14 cu.m. per minute, is returned to the concentrator.

In the flotation plant, the first in Upper Silesia to employ selective flotation, a lead concentrate is first produced in eight Callow-MacIntosh cells. Tailing from these cells, containing the zinc blende, is treated in two sixteen-cell subaërated Minerals Separation machines, where a zinc concentrate is produced. After thickening, both concentrates are dewatered with Wolff vacuum filters.



North-south section of Bleischarley mine and Heinitz mine. Horizontal Scale 1:30,000. Vertical scale 1:10,000

A Waelz plant with two kilns, 40 m. long and 1.8 m. in diameter, treats all the calamine produced. The zinc oxide gases from the kilns are treated in Cottrell precipitators, of Lurgi construction, consisting of two parallel 5-m. systems, followed by four paralled 3-m. systems. Precipitated oxide is conveyed by suction to a kiln, where most of the lead is volatilized by a chloridizing process, leaving the zinc oxide as a sinter. By this method the zinc content is raised to 63 per cent. The lead oxide is leached to remove chlorine and to give a higher content of lead sulphate. A cadmium slime is also produced in this process. Zinc is not recovered at present.

Electric power for operating all machinery, including air compressors, is obtained from a power plant in Upper Silesia. Of a total daily consumption of 34,000 kw.-hr., the concentrating plants take 24,000 kw.-hr. Two piston compressors, one of 6,000 cu.m. per hour, the other with a capacity of 1,500 cu.m. per hour, are used. A notable feature is the connection of the compressed-air system of the German Bleischarley mine with that of the Heinitz mine, through the Römhild shaft, an arrangement permitting equalization in case of uneven loads. The boiler house has three tubular boilers, each with 85 sq.m. heating surface. Steam is used only for heating purposes in the flotation plant, offices, and change houses. Other surface buildings comprise machine shop, blacksmith shop, carpenter shop, electric shop, and a laboratory. Production is shown in the accompanying tabulation.

	Metric Tons
Blende-galena ore	340,113
Galena-calamine ore	28,464
Zinc concentrate from jigs	133,590
Zinc flotation concentrate	20,840
Zinc oxide	7,357
Lead concentrate from jigs	12,291
Lead flotation concentrate	2,904
Lead oxide and sulphate	544

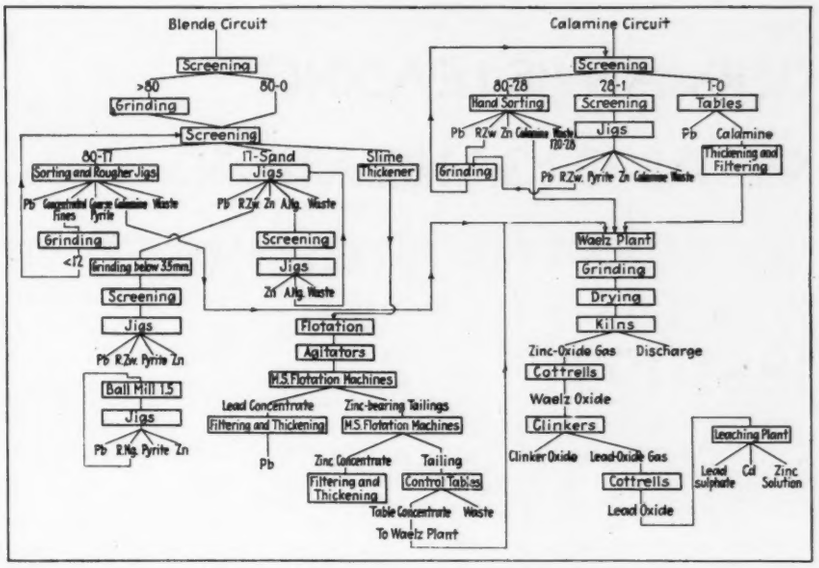
To be independent of the Polish smelters, and to utilize the ores from German Bleischarley mine to better advantage, the management plans to build a reduction plant at Magdeburg. A test plant with a daily capacity of 2.5 tons electrolytic zinc was operated to determine the most suitable con-

ditions for this type of ore. These tests are now completed, and plans for a plant have been made, the first unit to have an annual capacity of 40,000 tons of zinc.

As previously stated, certain outlying sections of the Heinitz mine are on the Polish side of the frontier. Mining of these has been made possible by German-Polish agreement. The deposits are worked through two main shafts to a depth of 660 m., with three auxiliary shafts for ventilating purposes. Of the levels driven from the main shafts, the 540-m. and the 660-m. levels are now worked. Mining is mainly by cross-cuts—only occasionally by raises and winzes. The beds vary in thickness from 1.5 to 6 m. or more. In the southern section the dip reaches 25 deg.; in the northern section it is from 5 to 8 deg.

A pillar method, typical of Upper Silesia, is used. The hanging wall is systematically caved, whereby a certain amount of coal, depending on local conditions, is left between individual pillars and is lost. In spite of a loss of from 15 to 25 per cent, this method is the most economical under present conditions. Only in special cases, as for instance where danger of subsidence exists, is underground filling used. Filling by compressed air displaced filling by hydraulic methods in 1930, when a blower of the Torkret type was installed, with a maximum hourly capacity of 60 cu.m. Experiments with other types of blowing equipment have been planned for 1931.

Blasting is required to mine the coal. Compressed air has been used for drilling only during the last two years, and electric drilling machines were recently introduced. Electricity is also used for underground lighting, to increase safety and to speed production. Long-wall mining is practiced in certain beds only, where layers of shale occur. Here the filling is brought in by hand. Rotary bar cutters or chain cutters are not used in these places, because the coal is so hard that blasting would be required even though such equipment were used. Filling is also done by hand only, as the pillars prevent the use of mechanical filling devices.



Flowsheet of concentrator and Waelz plant

Pb, lead concentrate
Zn, zinc concentrate
RZw, rich middling
RNg, rich end-product
ANg, low-grade end-product
Cd, cadmium slime

Mine cars of 620-kg. capacity are used for underground transport, as the mining method employed does not permit the use of larger cars. Only under specially favorable conditions is conveying to loading pockets possible. The coal is taken to the main haulageways in shambles or in cars run by gravity or by rope haulage. Electric locomotives, of 50 and 36 hp., are used in the main haulageways, with smaller locomotives for switching and gathering. Hoisting in one of the two main shafts is done with a Koepe unit, driven by a two-speed, 570-1,365-hp., d.c. motor, with Ward Leonard control. In the second shaft, two hoists are used, driven by two two-cylinder steam engines, each of 2,000 hp. Total daily hoisting capacity is 5,000 tons. The hoisted cars are sent to the cleaning plant by a mechanical switching arrangement. Material above 40 mm. is hand sorted, and material under 40 mm. is air-cleaned in a Kirkup-Carlshütte plant with an hourly capacity of 125 tons. Classification in sizes 40-10, 10-3, and 3-0.5 mm. is accomplished by seven jigs. The fine material below 0.5 mm. is not treated further. The air-cleaning plant is the first of this type in German Upper Silesia.

Electric power at 6,000 volts, bought from an outside power plant, is used mainly for operation of the machinery in surface plants and cleaning plants, for pumping, and for the electric hoist. Compressed air is produced by two turbine units, one of 14,000-cu.m., the other of 24,000-cu.m. hourly capacity. These compressors operate with exhaust steam from the hoists.

Production from the Heinitz mine in 1930 was 910,615 tons. At this rate the reserves should last about 100 years.

Surface plants at Heinitz coal mine

GERMANY'S LEADING METAL ORGANIZATION

CELEBRATES ITS FIFTIETH ANNIVERSARY

1881-1931

FIFTY YEARS AGO—on May 17, 1881 — Wilhelm Merton founded Metallgesellschaft in Frankfurt a.M., at a time when the metal trade of Europe was still centered in London. During the early years of the company's activity the demand for copper, lead, zinc, and other non-ferrous metals increased in a spectacular manner. Stimulated by this demand, many new deposits were developed. Great progress was made in mining and smelting practice, particularly in overseas countries. Taking advantage of this favorable situation, Wilhelm Merton and his able associates, L. Ellinger and Z. Hochschild, succeeded in securing for Metallgesellschaft a leading position among the metal-trading companies on the Continent.

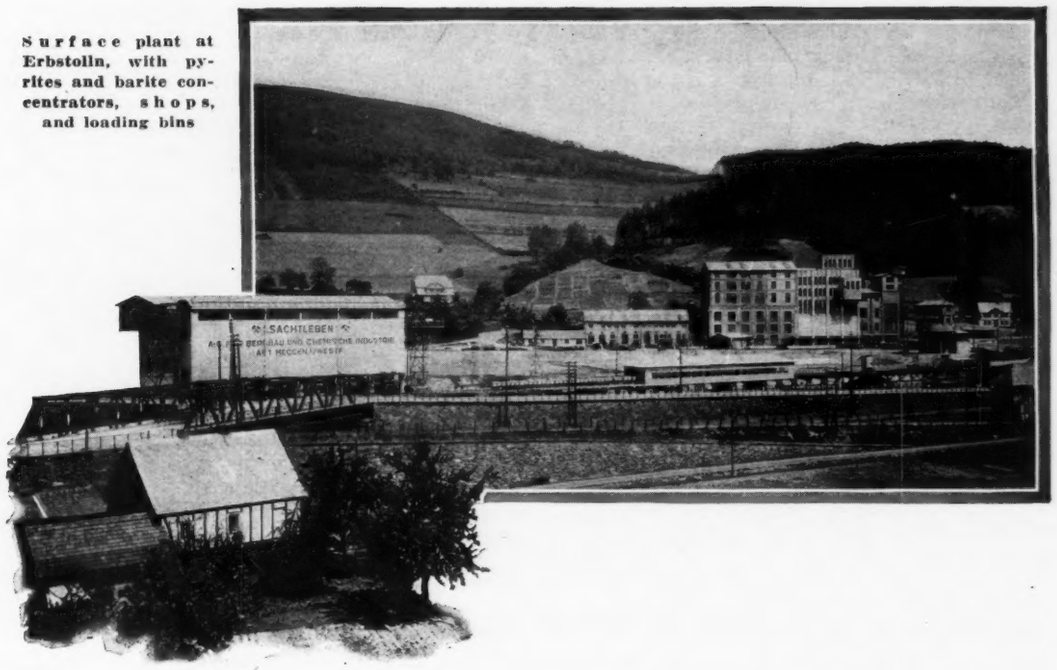
Realizing that the increasing concentration of production and consumption forced the metal industry to safeguard its position to the greatest possible extent, in regard to both of these factors, the leaders of the company gradually developed the original trading organization into an enterprise with world-wide interests. From the start a close connection had been maintained with the British firm, Henry R. Merton & Company, in London. In addition, American Metal Company and Australian Metal Company were founded. Interest was also acquired in many foreign mining companies, such as Mazarron, in Spain, and Peñoles, in Mexico. Alone, or in collaboration with other companies, Metallgesellschaft erected lead, copper, and zinc smelters, among which were the Hoboken smelter, in Belgium, the Berzelius zinc smelter, at Duisburg, and Norddeutsche Affinerie, in Hamburg. Manufacturing plants were also acquired, such as Heddernheimer Kupferwerke. Trading was extended to metallic ores and pyrites, in addition to virgin metals. Valuable experience gained by the industrial and commercial activities later led to the exploitation of patents and processes and the sale of technical apparatus and equipment.

At the death of Wilhelm Merton, in 1916, the capital of the original company had increased to eighteen million marks. Included in the concern's central organization were also Metallbank and Metallurgische Gesellschaft, with a capital of 40 million marks, and Société Suisse pour Valeur de Métaux, in Basel, Switzerland, with a capitalization of twenty million Swiss francs. This growth was achieved mainly from the company's own resources, without resorting to outside financing of a substantial nature.

The World War caused great changes in this international organization. Its foreign interests, especially the overseas mining and smelting enterprises, were lost. During the post-War period, a new structure had to be raised on the ruins of the old. Today, Metallgesellschaft's chief interests in the mining and smelting field are confined within the borders of Germany. The manufacturing plants belonging to the corporation have been recently merged into Vereinigte Deutsche Metallwerke. Wide experience obtained during the trying times of the War, and systematic research work, have led far beyond the original activities into new fields, such as the production of aluminum, chemical engineering, and the industrial application of heating processes. The trading business — the backbone of the organization —had to face the drastic structural changes in world economics following the War, which to such a great extent strengthened the predominant position of the United States in all fields. As Germany is the largest consumer of metals in Europe, the company's position is, however, strong and firmly established.

Metallgesellschaft emerged from the period of inflation in a favorable financial condition. At present its working capital is 70.86 million marks, and that of Société Suisse pour Valeur de Métaux, 25 million Swiss francs. After the death of the founder a new generation has taken the lead. Dr. e.h. Alfred Merton is now president of the company, and his brother, Dr. h.c. Richard Merton, chairman of the board of directors.

Administration building and headquarters of Metallgesellschaft, Bockenheimer Anlage 45, Frankfurt a.M.



Surface plant at Erbstoln, with pyrites and barite concentrators, shops, and loading bins

MINING AND CONCENTRATION AT MEGGEN

DR. ING. R. GLATZEL

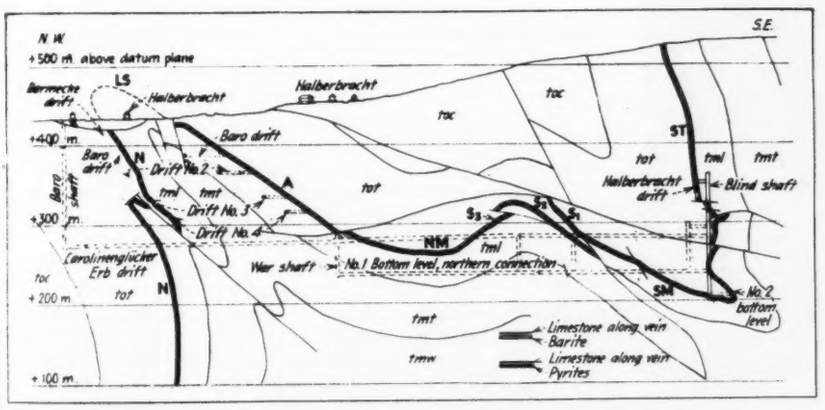


Fig. 1—Longitudinal section of the Meggen deposit

toc,	Cypridine shale	S_1,	Hanging saddle
tot,	Büdesheimer shale	S_2,	Middle saddle
tml,	Lenne shale	S_3,	Foot saddle
tmt,	Tentakulite shale	NM,	North vein
tmw,	Oderhäuser limestone	A,	Old deposit
ST,	South vertical vein	N,	New deposit
SM,	South horizontal vein	LS,	Eroded saddle

Upper Devonian

Middle Devonian

Producing more than 500,000 tons annually, the Meggen mines rank first among Germany's pyrites and barite deposits. Efficient concentrating plants have been built in recent years. Large ore reserves insure continued activity for about a hundred years at the present rate of production.

▼

IN MEGGEN, Westphalia, Sachtleben A. G. für Bergbau u. Chemische Industrie is mining zinc-bearing pyrites and barite. These deposits, the largest of their kind in Germany, have been known since the middle of the last century. At first only the surface gossan, or *eisenhut,* was mined. As greater depth was attained, mining of pyrites was begun, at first on a small scale, but gradually increasing, until the present production of about 330,000 metric tons per year was reached. Barite production started 40 years or so ago, when the manufacture of lithopone created a market for this product.

The Meggen property includes 325 claims with leases covering an area of 171,095,639 sq.m., including pyrites, iron ore, manganese ore, and zinc-lead-copper ores. The barite does not come under the mining laws, but belongs to the owners of the ground. To secure mining rights it has been necessary to buy land amounting to 2,700,000 sq.m.

The main part of the Meggen deposit is situated on the eastern bank of the Lenne River. In age, the formations are upper Middle Devonian and lower Upper Devonian, being similar to the deposits in the Rhenish slate fields. An idea as to the distribution and extent of

the deposits may be gained from the longitudinal section in Fig. 1. The deposits, as well as the country rock, are folded heavily. This folding, and the various portions of the deposits, are shown in Fig. 1. The vertical portion of the vein at the south end dips at almost 90 deg. to considerable depth, where it joins the flatter-lying section (*S M*), extending to the saddle (*S*), which, in turn, has its continuation in the northern section (*N M*). The northern branch (*A*) of this part of the deposit (the first to be worked) comes to the surface, where the top of the evident fold has eroded; *L S* indicates the imaginary course of the eroded saddle, the other limb of the fold (*N*, first opened up in 1912) continuing downward with an almost vertical dip. Its identification as a fold is verified by the fact that the limestone which south of this point forms the hanging wall here occurs in the footwall.

A large number of cross faults characterize the vein. These, however, have, caused only minor disturbances in the deposit. They are of a period subsequent to the folding, and probably were formed in late Carboniferous time. Two of the faults are of special importance: (1) the so-called "Halberbrachter Sprung," taking its name from the village through which it runs, and (*2*) the so-called "Natheller Störung," about 500 m. east of Halberbracht. Both faults show a westerly dip, with a perpendicular displacement of 20 m. and a horizontal displacement of about 60 m. In addition to the cross faults, several reverse faults in the direction of the strike are found. In Fig. 1 are shown two such faults in the southern saddle, dividing the deposit into three parts (*S1, S2,* and *S3*). An important reverse fault is also found in the lately discovered part of the vein (*N*).

The deposit is about 4.5 km. long in the direction of the strike (northeast-southwest). In width it is about 1.2 km. The dip varies greatly in the different sections. In the southern part the depth has been found to be about 300 m.; in the newer section the ore goes to a greater depth. In thickness the orebody is fairly uniform, varying from 1.5 to 8 m. and averaging 5 m. The changes in thickness occur gradually. On the eastern and western edges the vein gradually narrows, the limestone becoming correspondingly thicker until the vein matter disappears.

The ores consist of zinciferous pyrites and barite, the pyrites forming the central part and the barite filling the eastern and the western zones. In most places the vein is divided by a narrow stratum of clay slate into two benches, a lower or foot-bench, which to the naked eye appears solid and unstratified; and an upper, or hanging bench, of later origin, which shows a distinct stratification.

In general, the pyrites are of a dark gray to brownish green color, with rarely a metallic appearance, and are characterized by great toughness, hardness, and density. Another characteristic of the Meggen pyrites is a zinc content of 7 to 8 per cent. The intimately associated zinc blende is barely discernible without magnification. Small amounts of galena and chalcopyrite are also present. A special advantage of this ore is a low arsenic content, making it especially well suited for the production of arsenic-free sulphuric acid. The following is an average percentage analysis: sulphur, 42.36; iron, 33.01; zinc, 8.55; lead, 0.75; copper, 0.01; manganese, 0.15; arsenic, 0.06; silica, 7.19; alumina, 0.06; lime, 1.27; magnesia, 0.69; barium oxide, 0.11; alkalies, 0.54; carbon dioxide, 1.43; sulphur trioxide, 0.46; titanic acid, 0.10; oxygen, carbon, and combined water, 3.26 per cent, by difference.

Meggen barite, occurring in amorphous as well as in crystalline form, is of bluish-gray color. It is characterized by a high content of barium sulphate and a low silica content. The average percentage analysis is: barium sulphate, 94.0 to 96.0; silica, 1.5 to 2.5; ferric oxide, 0.5 to 1.5; alumina, 0.5 to 1.0 per cent. On account of the lower hardness it is much easier to mine than the pyrite.

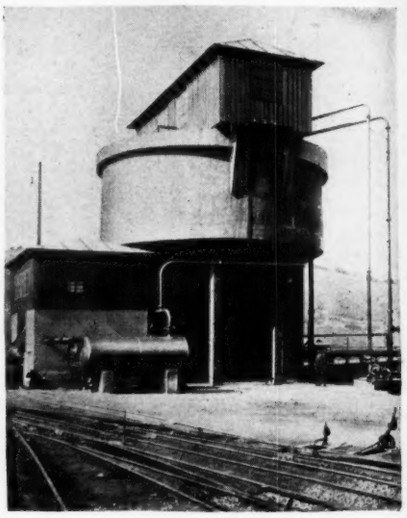


Fig. 4—Thickener for clarification of water used in washing barite

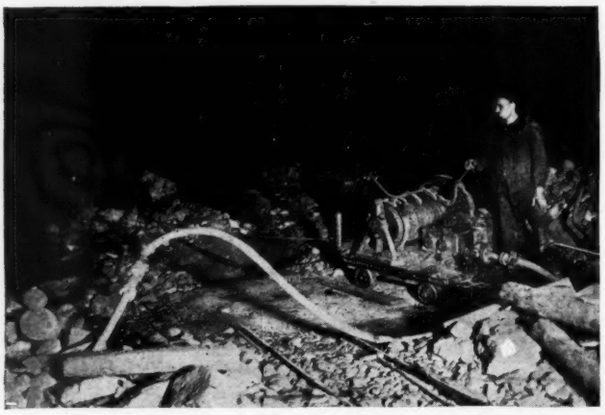


Fig. 2—Scraper hoist loading pyrites

Fig. 3 — Screening barite with 120-mm. bar grizzly

Genesis of the Orebodies—According to present theories, the pyrites and the deposits of barite have been formed simultaneously, or syngenetically; the older theory, that they were formed metasomatically by replacement of limestone, has been abandoned. Epigenetic origin of the orebodies seems also out of the question in the light of recent explanations.

Ore Reserves—Development work and drilling of both the pyrites and the barite deposits show that large reserves are available. At the present rate of production, about 500,000 tons annually, the deposits can be worked for about three more generations.

Mining—Topographic conditions of the Meggen field, as well as the great length and comparatively narrow width of the deposits, led to the adoption of the method of mining used. Drifts are run on the main levels in the direction of the strike, the levels begin 30 to 40 m. apart. There are seven drifts in all. The deepest and longest of these is 3,500 m. long. It is driven from the Lenne valley and is called "Karoli-

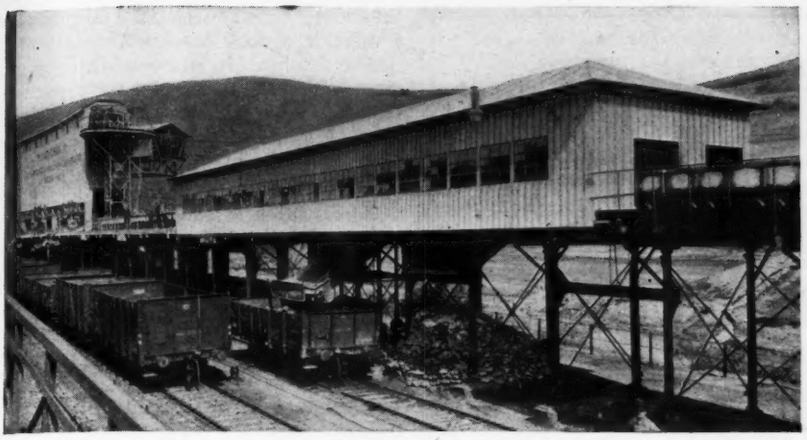


Fig. 5—Shipping bins with rope tramway

nenglüker-Erbstolln." At present it is the main haulage level. The north and the south portions of the deposit are connected through bottom levels 1 and 2, from which blind shafts or winzes are sunk to the Erbstolln level.

Each level is worked by driving a footwall drift in the country rock, from which crosscuts are driven at 20-m. intervals. Double tracks are laid in the drifts, which serve for locomotive hauling. Support of the drifts is usually unnecessary except where faulting has occurred. Here concrete is generally used.

The mining method is as a common practice adapted to local conditions. Where the deposit dips steeply, a cut-and-fill system is used; and, in places where it is horizontal, a room-and-pillar method. In either method a fill as compact and non-porous as possible is used, the better to support the hanging wall. Filling material is mined in so-called waste-rock stopes—that is, places in the hanging wall from which the rock is dropped directly into the workings. All rock obtained in development work and trimming, as well as waste and tailing from the sorting and washing plants, is used for filling.

Extraction of the pyrites and the barite is by drilling and blasting. As the pyrites is very hard, drilling with compressed air was introduced long ago. Air is supplied to the workings at about 100-lb. pressure through a system of pipes of different size (main line, 250 mm. diameter; service lines, 25 mm. diameter) which runs through the mine, the total length of pipe being 24 km.

The air is compressed in a two-stage Flottmann piston compressor having an hourly capacity of 6,000 standard cu.m., connected directly to a 800-hp. a.c. motor. Smaller compressor units, with a total hourly capacity of 9,600 standard cu.m., serve as spares, and are also used when extra air is needed. Over 300 Flottmann air hammers, with 55 mm. piston diameter and automatic feed, and six hammer drills with 65 mm. pistons, also with automatic feed, are used. All fishtail bits are sharpened with a Flottmann drill-sharpening machine. Cross bits are used only in fissured ground.

For breaking pyrites and for rock breaking, Dynamite I with 65 per cent gelatine is used; for breaking rock for fill, Dynamite III with 40 per cent gelatine. Average consumption is 225 grams of dynamite per ton of pyrites. A low-explosive chlorate ("Miedziankit") is used in mining barite, in order to reduce the amount of fines produced.

Tramming — The broken ore is dumped into pockets leading to the nearest track, then drawn into 2-ton mine cars. Altogether, about 2,000 cars are used, all equipped with roller and side-thrust bearings. A scraper hoist, made by Emil Wolf, Essen, installed about the middle of 1930 (see Fig. 2), has proved highly satisfactory. Tramming in the main haulageways and above ground is accomplished with 22 Deutz benzol locomotives, of 25 hp. and having a tractive power of 150 to 180 tons. Although the main hauling was formerly done on several levels, it is now confined to the Karolinen-Erbstolln drift, which in recent years has been modernized. This drift has three openings. The northern one leads through an inclined passage having a chain tram to the pyrites-crushing plant; the middle to the hoist for the barite-washing plant; the southern to the loading bridge. In certain sections the drift is equipped with four tracks, for spotting and making up trains. It is connected with the levels above, and with the deepest level, by four shafts—the West shaft, the Blind shaft, the Kriegs shaft (War shaft), and the Baro

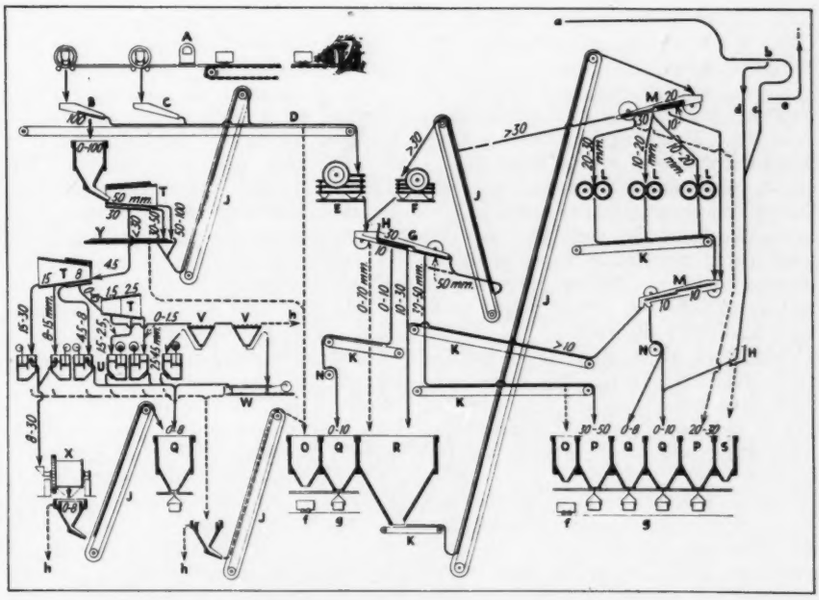


Fig. 6—Flowsheet, pyrites grinding and concentration

A, Automatic scales
B, Grizzly
C, Shaking feeder
D, Apron conveyor
E, Two jaw breakers, 1,000x600 mm.
F, Two jaw breakers, 800x450 mm.
G, Two double-deck shaking screens, 1,200 mm. wide
H, Deflector
I, Bucket elevator
K, Belt conveyor
L, Rolls, 1,250x300 mm.
M, Double-deck shaking screen
N, Sampler
O, Rock bin
P, Bin for furnace pyrites
Q, Bin for fine pyrites
R, Storage bin
S, Bin for dust
T, Rotating screen
U, Jigs
V, Cones
W, Shaking table
X, Ball mill
Y, Sorting table
a, Suction line to all points where dust is created
b, Collecting duct
c, Filter
d, Dust
e, Fan
f, Haulage to mine
g, Haulage to loading bins
h, To settling pond
i, Discharge to open air

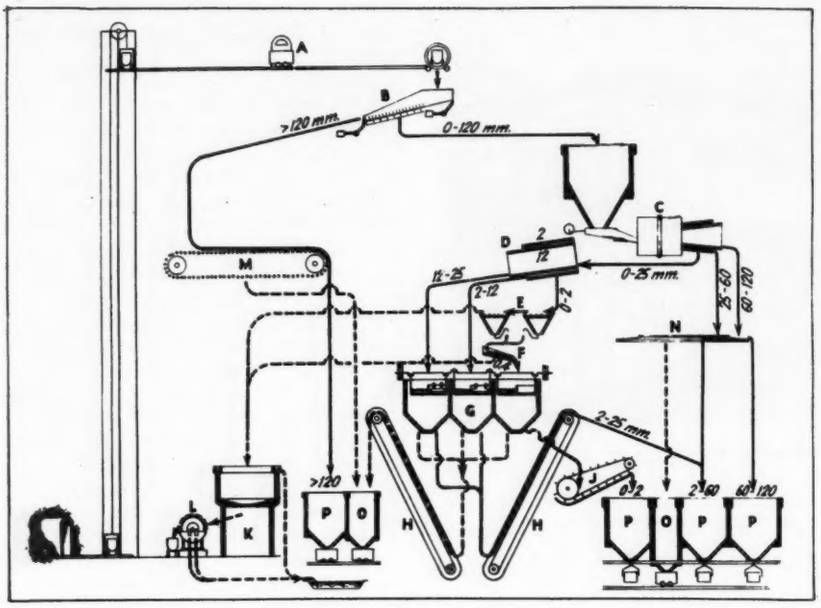


Fig. 7—Flowsheet, barite concentration

A, Automatic scales
B, Bar grizzly
C, Washing trommel
D, Trommel screen
E, Cones
F, Plate screen
G, Three-cell jig
H, Bucket elevator
I, Drag
K, Thickener
L, Filter
M, Roller conveyor
N, Sorting table
O, Rock bin
P, Barite bin

shaft. Electric hoists are used in all.

The water in the mine varies with the precipitation, the average for the year being about 1 cu.m. per minute. A large part of the water runs out through the drifts. Pumping is necessary only on the deepest level, where three pumping stations with a combined capacity of 2.4 cu.m. per minute are installed. As the mine water is acid, the exposed pump parts are made from zinc-free phosphor bronze. Before the water is discharged into the Lenne River it is neutralized and clarified.

Ventilation of the mine is by natural draft. Numerous drifts and a few airshafts give sufficient good air. Electric light is used in some of the main drifts, and carbide lamps are used in the remainder.

Surface Operation—During the last five years important improvements have been made in the surface plants. The concentration plant is divided into three sections—the pyrites concentrator, the barite concentrator, and the flotation plant. In the pyrites concentrator, the important part of the process consists in reducing the pyrites to the size suitable for roasting. This is accommplished by various steps of grinding and screening. As a rule, the pyrites is delivered in sizes of 30 to 50 mm. (furnace pyrites) and 0 to 10 mm. (fine pyrites). Occasionally, 10 to 30 mm. and 50 to 70 mm. are produced. The concentration process is of minor importance, as the pyrites is already highly mineralized. Some enrichment is attained by hand sorting and jigging. The sales product is guaranteed to contain at least 42 per cent sulphur.

Fig. 6 contains the flowsheet of the crushing plant, built in 1928 by Gröppel, Bochum, Germany, having a capacity of 1,000 tons per seven hours. The plant is divided into three parts—preliminary crushing, fine crushing, and the mechanical concentration department. As much as possible of the finished product is obtained in the first operation, to take the load off the fine-crushing plant. Possibly for the first time in a concentration plant a double-deck shaking screen is used, having a much higher efficiency than the trommel screen (perhaps two to five times higher). High-speed, 1,250-mm. rolls are used (90 r.p.m.), completely inclosed to reduce dusting. Samples of the fine pyrite are taken from the belt conveyor by two automatic samplers. A crushing plant built by Humboldt in 1925, of the same capacity, serves as a spare. It may be put into operation immediately should a breakdown occur in the regular plant. The dust made by the crushing is sucked through a filter plant with 36 cu.m. per minute capacity, operating at a suction of 40 mm. water. A stationary vacuum cleaner, built by Berg & Company, Köln-Kalk, working with a suction of 3,000 mm. water, is used for collecting dust settling in the plant. Machines in the crushing plant have individual drives. The newest construction of Siemens Schuckert prevents dust or moisture entering the motor armature, affording good protection against breakdowns.

The finished product is taken by rope tramway of 130 tons' per hour capacity, built by Pohlig, Köln, to the shipping bins (Fig. 5), providing storage room for 1,000 tons, in separate bins according to size.

Barite Concentration—The barite concentrator, built by Fried Krupp Grusonwerk A. G., Magdeburg-Buckau, for an output of 70 tons per hour, has been in operation since August, 1928. Generally speaking, the barite may be marketed directly without treatment, as it contains hardly any barren material. In a technical sense, no concentration is therefore required. The washing plant serves principally to improve the appearance of the barite, which contains

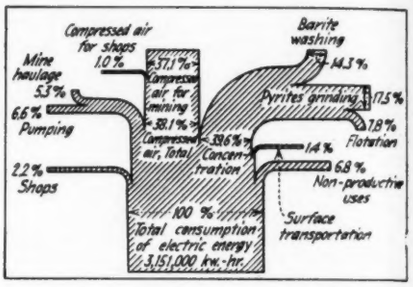


Fig. 8—Distribution of electric energy for the year 1930

a small amount of clay. This is accomplished by intense washing with water in trommels and jigs and partly by hand picking. By these operations the content of $BaSO_4$ is raised above 95 per cent.

In contradistinction to the practice at most concentrating plants, no crushing is done in the barite concentrator. The flowsheet given in Fig. 7 shows the method of operation. An inclosed, three-cell percussion jig and a 120-mm. Seltner bar grizzly used in classifying the material, shown in Fig. 3, have given excellent service. A Krupp thickener of 10-m. diameter (Fig. 4) is used for clarifying the wash water.

As practically all of the barite sold is reduced, a high content of $BaSO_4$ and as low silica and alumina content as possible are important considerations, whereas the question of color is not so important. Tests have, however, been made to improve the color. At the Homberger plant of Sachtleben A. G. a method has been developed whereby the bluish-gray barite is converted into a more valuable white product.

Metallurgy—From the beginning, attempts have been made to utilize all of the metals contained in the Meggen pyrite, especially the iron and the zinc. Buyers of the pyrite therefore have to return the cinder, the treatment of which has always constituted an important part of the company's operation. Owing to the high zinc content, 10 to 11 per cent, the cinder cannot be used

directly for the production of pig iron. Zinc and sulphur must first be removed. Up to the present a chloridizing roast was used, to supply zinc for manufacture of lithopone; but the demand for this product is not sufficient to take care of the large tonnage of cinder. Improvements in the technique have, however, led to new methods for rational treatment of the cinder. Development of the Waelz process resulted in a large experimental plant in Stürzelberg, where about one million tons of zinc-bearing cinder is stockpiled. After some difficulties, this plant has obtained favorable results. Recovery of zinc and production of a good iron ore from the cinder must therefore be considered as solved.

In addition to the recovery of zinc and iron from the cinder, the idea of a concentration process to remove the zinc at the mine was also presented. As already stated, zinc blende and pyrites occur in an intimate mixture. As a wet, mechanical process was of no avail, only concentration by flotation remained. Based on results obtained by German and foreign concerns, Krupp was engaged to build an experimental flotation plant, in which the proposed methods could be tested on a commercial scale. The important point to consider was that, without too fine grinding, the pyrite produced should contain only 8 per cent zinc, in order to give a satisfactory cinder that could be used as iron ore. The flotation plant (Minerals Separation and Callow-MacIntosh procedure) has been in operation since December, 1928. Fig. 9 shows the arrangement and construction of the plant. The crushed material, 0-10 mm., is ground to pass 120 mesh, giving a pulp to the flotation machines containing 80 per cent below 250 mesh. Intimate distribution of the blende in the pyrite necessitates this fine grinding. Classifier discharge, with 200-250 grams solids per liter, is not thickened, but goes directly to the flotation machines. The flotation concentrate is thickened and filtered. All intermediate products of the milling operation are returned to the flotation circuit.

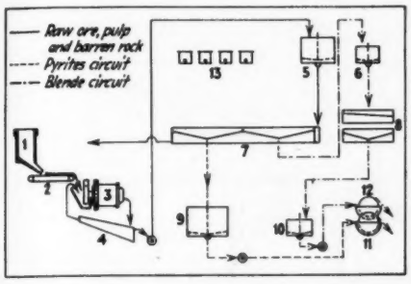


Fig. 9—Flow sheet, experimental flotation plant

1 Bin
2 Belt feeder
3 Ball mill
4 Dorr classifier
5 & 6 Primary thickeners
7 M.S.Flotation machine, 14 9-in. cells
8 Callow-MacIntosh machine, 2-cell
9 & 10 Concentrate thickeners
11 Drum filter
12 Leaf filter
13 Reagents feeders

After a comparatively small amount of experimentation, the results show that the problem of separating the blende from the pyrite, producing a zinc concentrate, may be considered solved. After five months' experiments a monthly zinc recovery of 94 per cent was obtained, producing a zinc concentrate with about 59 per cent zinc, and a pyrite with 42.0 per cent sulphur and 0.65 per cent zinc. The tests also showed that the Callow-MacIntosh pneumatic cell is better suited for concentration, whereas the Minerals Separation apparatus (Fig. 10) worked equally well in regard to recovery and concentration. The following reagents and chemicals were used: Lime, copper sulphate, potassium xanthate, P U oil, pine oil or dipentene. Reagents cost 1.40 marks per ton of ore.

Further tests were also made to enrich the pyrite. A concentrate with 48 per cent sulphur was produced by first floating pyrites and blende together in a neutral circuit. From the mixed concentrate the blende was floated, using the reagents commonly employed for this purpose. By this method a zinc concentrate with over 56 per cent zinc, and a pyrites concentrate with 48 per cent sulphur and 0.8 per cent zinc, were produced, with a recovery of 92 per cent of the zinc and 85 per cent of the sulphur.

The small testing plant, equipped with everything needed for sampling and control, with an hourly capacity of 150 kg., fulfilled all expectation in a satisfactory manner. All problems attacked were solved, and the practicability of the process was demonstrated. This work removed all objections to the building of a commercial plant, and the plans for such a plant have been completed. The execution of these plans has, however, been postponed on account of the low zinc price and general poor market conditions.

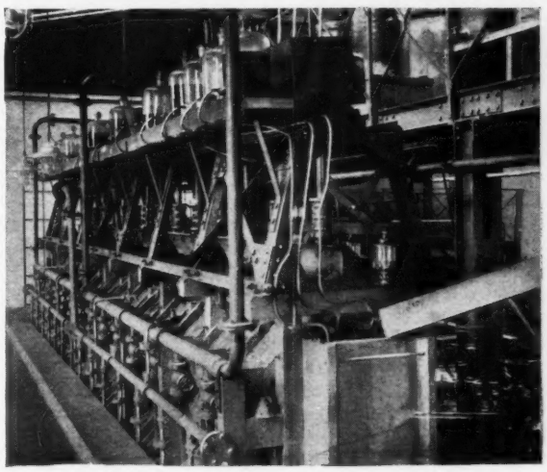


Fig. 10—Fourteen-cell, sub-aërated M.S. machine

Some difficulties were experienced in roasting the wet pyrites concentrate. These, can, however, be solved by drying the filtered concentrate to about 3 per cent moisture. The dried product gave excellent results in mechanical hearth furnaces as well as in the Lurgi kilns, and a cinder with less than 1 per cent sulphur was produced.

Power Consumption—The power used in the mine and in the surface plants is obtained at a tension of 3,000 volts from Siegerländer Electric Company's network, which is connected to the Rhenish Westphalia Electric Company's system. Consumption of electric power and its distribution are illustrated in Fig. 8. The total length of power lines on the company's property is about 11 km.

Personnel and Welfare Work—With a monthly production of 40,000 tons, a crew of about 850 men is used, 69 per cent underground and 31 per cent on the surface; 28 per cent is engaged in breaking ore, 16 per cent in underground haulage, and 10.5 per cent in concentration. About a third of the men live in company houses. A total of 92 houses with shelter for 312 families is available, partly one-family houses and partly modern colonies. Among other welfare activities are a nursing home with kindergarten, sewing school, care for sick and convalescent, athletic field, gymnasium, free bath, first-aid squad, and similar activities. In the mine an eight-hour day is the rule, and on the surface a 54-hour week is in operation.

Sales Organization—Of the pyrites produced in 1930, 69.6 per cent was used for the manufacture of sulphuric acid and phosphate, 26.4 per cent by the paper and cellulose industries, and 2.2 per cent for the manufacture of lithopone. When the flotation plant is operating, the zinc smelters will also be customers. With a yearly production of 350,000 tons of pyrites, and a recovery of 7 units of zinc by flotation (1 unit = 1 per cent), about 50,000 tons zinc blende with 50 per cent zinc will be put on the market. The barite is used mainly for manufacture of lithopone and barium salts, and in the linoleum and paper industry. Lately it has also found some use in the petroleum industry, as so-called oil spar, in the drilling of wells, and in the refining process. A special sales organization markets all of the products.

NORDDEUTSCHE AFFINERIE

Electrolytic copper, lead, silver, gold, antimony, bismuth, and cadmium are the chief products of Norddeutsche Affinerie. The company has the distinction of having pioneered in electrolytic metal refining, and the plant presents an interesting example of growth from a small gold and silver parting plant to the present complex structure.

DR. ING. E. van ERCKELENS

NORDDEUTSCHE AFFINERIE (North German Refinery) developed from a gold- and silver-parting plant, the foundation of which may be traced back to 1785. In connection with the parting of precious metals, this plant undertook, during the first half of the nineteenth century, to melt copper ore on a small scale. In 1866, a company under the present name, Norddeutsche Affinerie, was formed by Norddeutsche Bank in Hamburg. The undertaking received strong impetus by the introduction of electrolytic refining methods, when a generator made by Gramme, exhibited at the Vienna Fair in 1873, was acquired. Favorable results obtained with this machine led to an order for a larger generator, and in 1875 Dr. Emil Wohlwill was able to introduce his method of silver electrolysis in sulphuric acid solution.

On July 1, 1876, Norddeutsche Affinerie started the first German electrolytic copper plant. With a yearly production of 2,000 metric tons, an output of importance in those days when the electrical industry was in its infancy, the company for many years held a leading position. In 1878 Dr. Wohlwill also introduced the present electrolytic gold refining process. In the 'nineties the rapidly increasing demand for electrolytic copper led to the building of the large, well-equipped American refineries which produced copper at such a low cost that European refineries were unable to compete. Affinerie was therefore forced to continue copper refining as a process secondary to the main process of parting gold and silver, under the most unfavorable conditions, in a building of several stories, within the city limits, and with the most primitive equipment. In 1907, the decision was made to reorganize with the aid of Metallbank and Metallurgische Gesellschaft, in Frankfurt a.M. A modern plant was built and put in operation in 1909-10. Up to 1914 it consisted of an electrolytic department with an annual capacity of 10,000 tons of copper, reverberatory furnaces for refining blister and cement copper, small blast-furnaces for treating intermediate copper and lead products, a lead refinery, and a precious-metals refinery. During the War, production increased to 25,000 tons of copper per year. After the War, it became necessary to rebuild the plant, especially the smelter, the size, equipment, and construction of which were not of right proportions compared with the refinery, making competition in the world market difficult. The result of this construction was the existing plant.

The present enterprise, with a capital of 12 million marks, owned by Metallgesellschaft, Deutsche Gold und Silber Scheideanstalt, and British Metal Corporation, operates a modern copper and

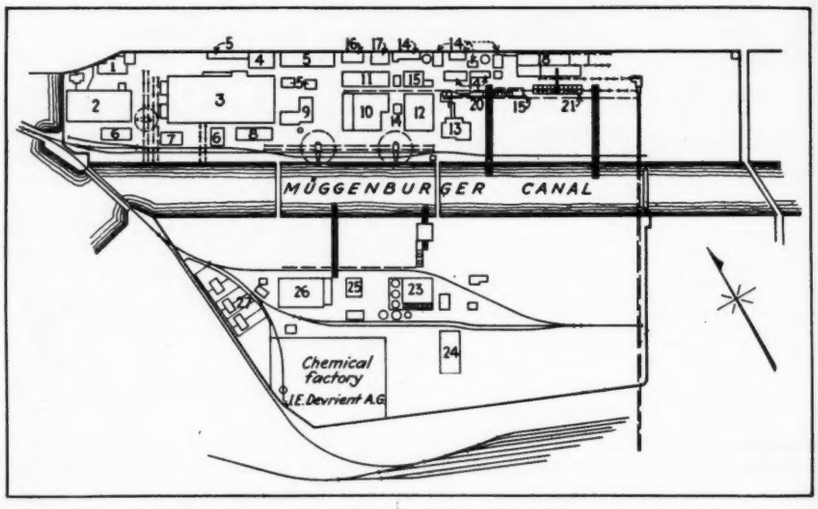


Fig. 1—General arrangement of plant, scale 1 : 3,000

1 Change house
2 Anode and wirebar casting
3 Electrolytic copper department
4 Cuprous-oxide plant
5 Shops
6 Cathode storage
7 Matte storage
8 Coal-dust grinding
9 Engine room
10 Harris plant
11 Precious-metal plant and laboratory
12 Dwight & Lloyd plant
13 Ore sampling
14 Dust precipitation
15 Sampling of previous-metals products
16 Offices
17 Warehouse
18 Blast furnaces and converters
19 Grinding plant
20 Mixing bins for Dwight & Lloyd
21 Blast furnace bins
22 Roasting plant
23 Sulphuric acid plant
24 Lead, cadmium, antimony electrolysis
25 Bluestone storage
26 Bluestone plant
27 Employees' dwellings

Aerial view of plant, situated on both sides of the Müggenburger Canal, directly connected with the river Elbe and the harbor of the city of Hamburg

lead smelter, where copper ore, lead ore, and copper-lead ore may be treated in all proportions. Present capacity is as follows: Blast furnaces, 800-900 tons per day; lead refinery (Harris process), 40,000 tons per year; copper electrolysis, 70,000 tons per year.

As the amount of copper and lead ore treated in the blast-furnace plant depends on economic conditions, the actual production of copper and lead varies within wide limits. Production during the last fiscal year was 18,000 tons of soft lead and 69,600 tons of electrolytic copper. Possibilities of extending the plant, however, are not limited to the capacities given, as the company owns 280,000 sq.m. of land, of which a quarter is still vacant.

The plant is situated on a site well suited for industrial development, on both sides of the Müggenburger Canal, connected with the river Elbe and the harbor. A water front, 850 m. long, and railroad spurs on both sides of the canal, afford favorable transportation facilities. On the north side of the canal are the smelter buildings (Fig. 1). In the eastern half are the ore storage, blast-furnace, and converter building (18); Cottrell treaters and baghouses (14); Dwight & Lloyd installation (12); lead refinery (10), and precious-metals refinery (11). On the western half of the property are the copper electrolysis (3) and the refining furnaces (2). On the south shore are the chemical works; roasting plant (22); sulphuric acid plant (23); purification plant for the electrolyte (26), and a building for miscellaneous operations (24), such as lead electrolysis, antimony electrolysis, cadmium leaching and electrolysis.

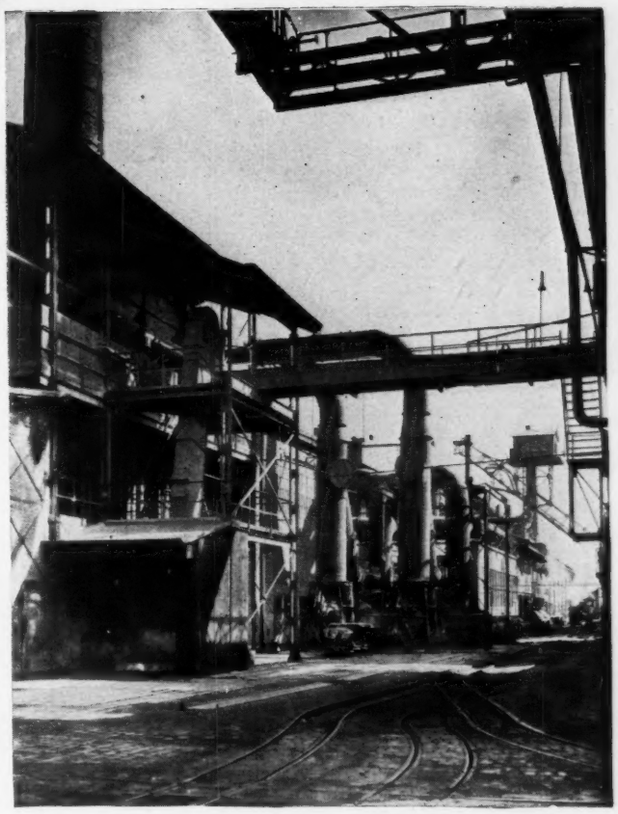


Fig. 2 — Gas-treatment plant, consisting of three baghouses and eight multiple-chamber electric precipitators. Blast-furnace plant with skip hoist in the background.

Smelter—As the company lacks raw material of its own, the smelter is designed to treat a variety of coarse and fine ores and intermediate products, such as pure copper and lead ores; mixed copper-lead ores; sulphide, oxide, and silicate ores. The ore is transported from the port to the plant in barges, unloaded with two 12-ton ore bridges, each with an hourly capacity of 80 tons, either directly to stockpiles or into large concrete bins. Fig. 4 shows the bridges and stockpiles, with concrete bins, blast-furnace plant, and skip hoist in the background. The fines, when not used for production of sulphuric acid, are roasted and sintered in the Dwight & Lloyd plant. In this event they are taken from the storage to a row of bins, shown in the picture to the left of the concrete bins. These bins feed directly to hoppers, mounted on a scale. A belt conveyor, under the bins, delivers the weighed ore and fluxes for the Dwight & Lloyd plant to a mixing trommel. After thorough mixing, the charge is taken on belt conveyors to the feed bins of the Dwight & Lloyd machines, of which the plant has two straight units with 18 sq.m. and two circular units with 16 sq.m. available roasting surface, of Lurgi construction. Maximum daily capacity is 500-600 tons. Coal dust is used for ignition, and a fan draws the gas to the stack through a baghouse or a Cottrell treater.

Electric tram cars of 30 tons' capacity, bottom dump, run above the bins. The cars, as well as the bins, may be loaded with the bridge. In filling the bins, the tram primarily serves as connection between the bridge and the individual bins, permitting convenient transportation of ore from all stockpiles to any bin without lateral movement of the bridge. The tram extends to the Dwight & Lloyd plant and delivers the sinter to the blast-furnace bins after it has been raised in a bucket elevator. In the Dwight & Lloyd plant the pro-

cedure used depends upon the type of ore handled. In the treatment of copper ores, the feed generally contains 14 per cent sulphur, the sinter 4 per cent sulphur. Lead ores with 16 per cent sulphur are pre-roasted to 10 per cent and reroasted to produce a sinter with less than 2 per cent sulphur.

In the blast-furnace plant are three mechanically charged furnaces of 500, 250, and 150 tons' capacity respectively. Under the concrete bins, feeding these furnaces, is a car on which are placed the charging buckets, which are weighed continually, so that the amount drawn from each bin is closely regulated. Platform and buckets are revolved during the filling, to divide the charge evenly. The car is then pulled under the skip hoist and the buckets are lifted to the top of the furnaces. Here the 3-ton bottom-dump bucket is placed on a car, taken over the furnace, and dumped. Two men and a weigher charge three furnaces.

The largest blast furnace is a straight water-jacket unit, 7 sq.m. at the tuyères and 7.4 m. from tuyères to charge floor. It treats mainly copper ore and concentrate, with 12 per cent copper in the charge. Average slag analysis is: 35 per cent iron, 34 per cent silica, 7 per cent lime, 2 per cent alumina. Slag and 50 per cent copper matte run continually to a water-cooled settler, the slag overflowing into a furnace fired with coal dust, which also handles the converter slag. From this furnace the slag is taken to the dump after granulation. Matte is tapped into 10-ton pots and charged to the converters. As the copper is not drilled or sampled it is cast in 2-ton cakes, to simplify pouring, transportation, and charging to the refining furnaces.

The operation of the two other blast furnaces varies. When treating pure lead ore or lead-copper ore, the lead or the lead-copper matte flows into the settler. The lead is tapped into 30-ton wrought-iron pots, skimmed, and poured into 3-ton molds. The pig lead is then taken to the Harris plant for refining. Matte from copper-lead ores, containing about 28 per cent copper and 18 per cent lead, is stored and treated intermittently in the blast furnace, concentrated to 47 per cent copper and 25 per cent lead, and then converted. Most of the bismuth-bearing byproducts, mainly obtained from the precious-metals refinery, are also treated in the blast furnace.

According to the operation of the blast furnaces, dust collecting is accomplished in a special system of baghouses and Cottrell treaters. Fig. 2 shows part of the gas-treatment plant with blast-furnace plant and skip hoist in the background. Three baghouses and eight multiple-chamber Lurgi precipitators are used. D. & L. machines, blast furnaces, and converters may be connected with the gas-precipitation plant in many ways; the operation may be changed to obtain the advantages of a baghouse or of Cottrell treaters as the specific condition may demand. In addition to the need of reducing metal losses, the proximity to a large city calls for negligible contamination. Gases are discharged almost completely free from dust through two 100-m. stacks. Flue dust, 12,000 tons yearly, is charged to the blast furnaces after sintering in pots or on D. & L. machines.

Fig. 3—Electrolytic copper department, 1,252 cells, arranged in Walker system

Copper Refining—The blister from the converters is hauled by locomotives to the western part of the plant, where the anode and wirebar furnaces and the copper cell room are situated. With a monthly production of 5,500 to 6,000 tons of electrolytic copper the local converter plant is able to supply only part of the blister. The remainder is made up with imported blister and cement copper. Blister is unloaded with four cranes, running toward the canal between the refinery and the electrolytic department. The copper is either placed in the refinery storage or stockpiled within reach of the cranes. Sampling at a rate of 12 tons per hour is done with a high-speed radial drill, with mobile revolving table.

In the casting building are four furnaces—two anode and two wirebar. Each anode furnace has a capacity of 230 tons, but one furnace only is in regular operation. The furnaces are fired with coal dust and are built as follows: On the bottom, made from iron plates, is placed a flat layer of firebrick; then a layer on edge, 23 cm. thick; then a layer of magnesite brick, 23 cm. thick. Furnace walls are completely lined with magnesite, and the skewbacks over the

Fig. 4—Ore bridges and stockpiles, with concrete bins in the background

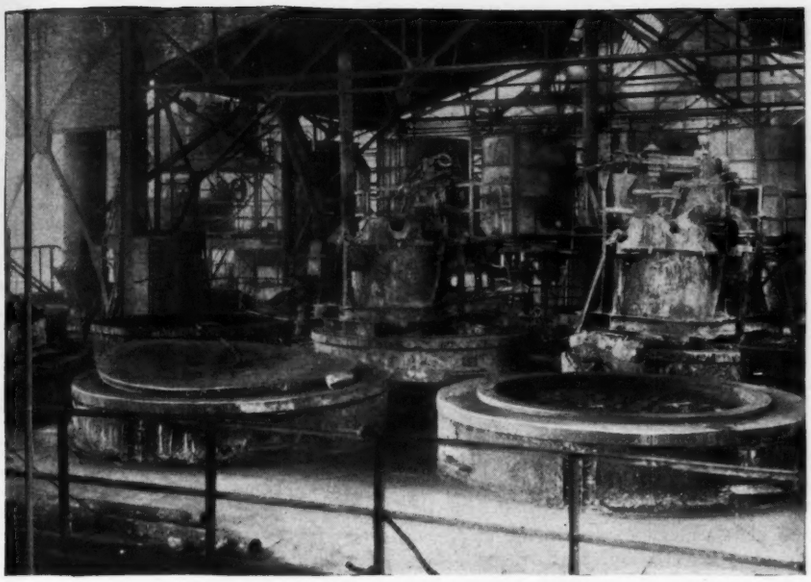


Fig. 5—Harris plant for refining lead

doors are water-cooled. The roof, made from 30-cm. silica brick, will outlast about 100 charges. The gases are used in a waste-heat boiler, with 450 sq.m. heater surface and 108 sq.m. superheater surface, producing 100 tons steam daily, at 175-lb. pressure.

When charging the furnaces a crane delivers copper from the stock to a bench opposite the furnace door, where it is taken by a revolving charging crane and stacked in the furnace. Oxidation is started after twelve hours' smelting. The blowers have a capacity of 25 cu.m. per minute at 15-lb. pressure. Total time required per charge is 24 to 36 hours; rate of pouring is 30 tons per hour. Copper molds with an average life of 3,000 pourings are used. The anodes are taken from the molds with compressed-air hoists, lowered into a cooling sump, lifted out by crane, and placed on cars. The slag, about 5 per cent of the anodes produced, is crushed with a magnetic skull breaker and sent to the blast furnace.

As shown in Fig. 3, the cell room, composed of eight bays running north-south, is 144x62 m. and has 1,252 wooden cells, 0.9x3 m., 1.3 m. deep, lined with hard lead, arranged according to the Walker system. Two cells form a cascade, and the cells are arranged in 30 groups of 40 or 48, with two groups combined to one circulating unit. Circulation is maintained with hard-lead or hard-rubber centrifugal pumps. Flow into the upper cell of the cascades is regulated with individual stoneware valves; stoneware launders are used between the upper and lower cells and stoneware pipes at the discharge into the return launders. Each circulation unit has a heating tank in the cellar.

The electrolyte averages 30 grams copper, 160 grams sulphuric acid, 6 grams nickel, and 8 grams arsenic per liter and has an average temperature of 55 deg. C. Each cell has 33 anodes, 65x88 cm., weighing 160 kg., spaced 9 cm., and 34 cathodes. Current density is 160 amp. per square meter, 6,000 amp. per unit, and current efficiency 92 per cent. A small part of the power is developed in a local steam plant, in generators connected directly to the steam engines, the exhaust of which is used for heating purposes. The major part of the power, however, is supplied at 6,000-volt alternating current by an outside plant and converted in motor-generator sets with 110 volts' tension. The cells are arranged in one or two electrical units, with the required number of generators in series. Intake and outlet of the current from the generators are so arranged that voltage to ground does not exceed 110. Vertically stripped, 24-hour starting sheets are hung with hollow copper rods, of 13x22 mm. cross-section. After twelve days the first crop of cathodes is pulled; scrap and the second crop after 24 days. Anode slime is drained through holes in the bottom of the cells, settled in large boxes, and filter pressed.

A few cathodes are sold directly, but most are melted in wirebar furnaces, each of 170 tons' capacity, and constructed as the anode furnaces. Casting into pressed copper molds proceeds at a rate of about 40 tons per hour. Great care is taken in testing the wirebars. Every half hour a bar is tested in a near-by laboratory, furnished with band saws, miniature rolling equipment, wire-drawing outfit, annealing furnaces, polishing machinery, and other equipment. Oxygen is determined by a metallographic method, and the result is available four minutes after pouring the bar. Representative samples from each charge are also tested for conductivity, number of bends, and copper content. Control of weight and inspection of the bars for physical defects are done with the same care as the laboratory tests.

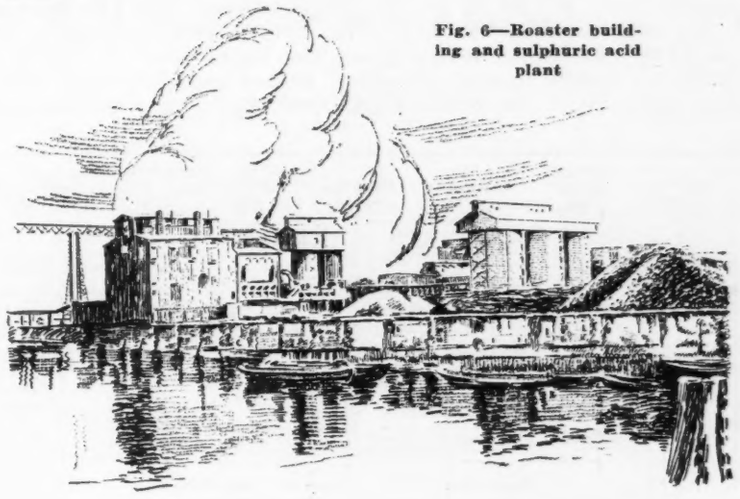


Fig. 6—Roaster building and sulphuric acid plant

Foul copper electrolyte is pumped to the bluestone plant, south of the canal. Here the free acid is partly neutralized with roasted cement copper. The solution is then evaporated and cooled by blowing air against the surface, whereby the main part of the bluestone appears as fine crystals within ten hours. The impure bluestone is dissolved and recrystallized over a period of six to seven days. Large crystals produced are washed in a trommel, centrifuged, and packed graduated in different sizes. About 500 tons is produced monthly.

Nickel salts are recovered when the concentration is high. Arsenic is also removed during this process. The intermediate arsenic-bearing products are worked into arsenic compounds in the near-by plant of Devrient A. G., in which Affinerie has an interest. These products, such as paris green, lead arsenate, and calcium arsenate, are used mainly as insecticides.

Lead Refining and Precious-Metal Work—Pig lead from the local blast furnaces and from outside smelters is

refined by the Harris process. Production varies according to ore deliveries. Seven 60-ton kettles are used for refining and desilverizing. Copper is taken out with sulphur after skimming the dross; arsenic, tin, and antimony are eliminated by the Harris process. Zinc is used for desilverizing. Fig. 5 shows the plant, with kettles in the foreground, two of which are operating with the Harris machine, and tanks and agitators for the salt-treatment process in the background. Ingots weighing 50 kg. are cast on a wheel at a rate of 20 tons per hour. The method used for treating the salt has been completely covered in previous descriptions of the Harris process. Tin is sold as calcium stannate; antimony is removed as sodium antimoniate; and zinc as oxide. The sodium antimoniate is reduced to raw antimony in a small reverberatory furnace and cast into anodes. These are refined by electrolysis in a solution of hydrofluoric and sulphuric acid, by a patented process producing 99.7 per cent antimony.

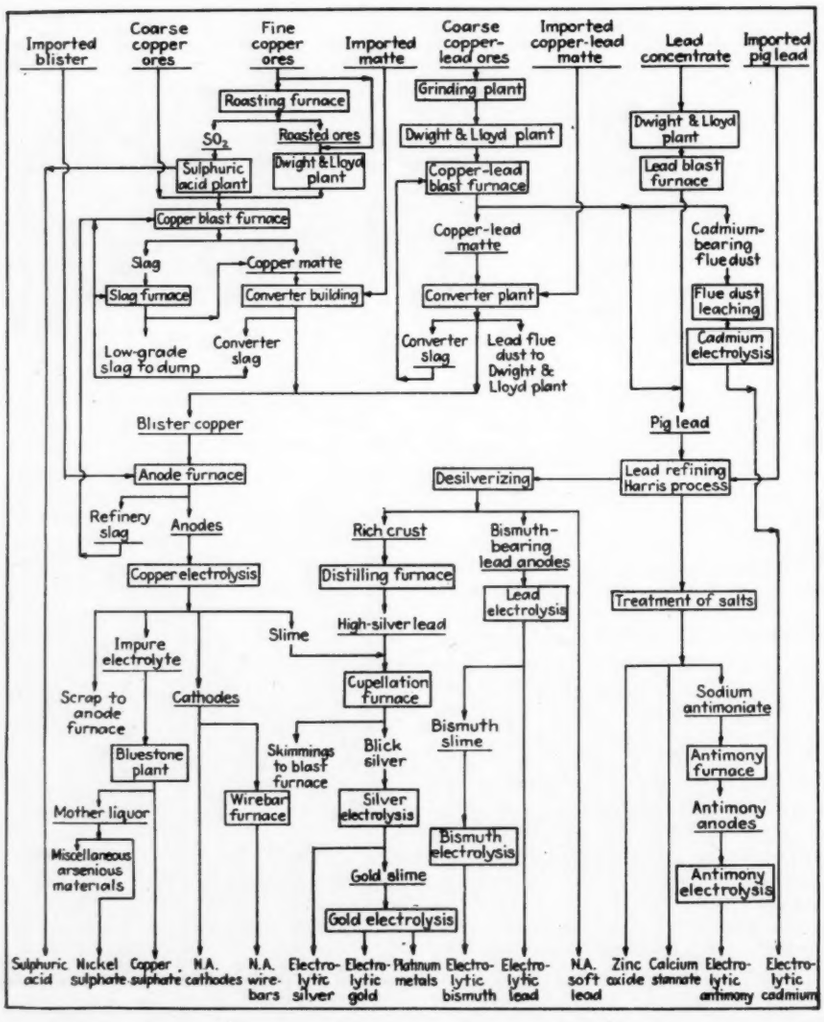
The rich silver-zinc crust is first treated by a sweating process and then distilled in a muffle furnace, recovering part of the zinc. The rich lead goes with the slime from the copper electrolysis to the cupellation furnaces. Unlike most plants, where copper is kept out of the intermediate products in the silver-refining process, and where the slime is leached before smelting in the Doré furnaces, the slime is here added directly to the lead bath in a cupellation furnace, without preliminary treatment. The product from this furnace, raw silver, is cast into anodes for the silver electrolysis, which follows the Moebius system, with some changes in equipment. The electrodes are hung vertically in stoneware cells; the anodes are wrapped in bolting cloth. Porous silver is removed from the cathode by a scraper with pendulum movement. A maximum of 25 tons of silver per month is produced. Gold slime is cast into anodes and recovered by the Wohlwill process, electrolysis in chloride solution. Platinum metals concentrated in the electrolyte are recovered by standard methods.

All intermediate products from the cupellation plant contain bismuth and are smelted in a blast furnace. The bismuth-bearing pig lead is treated in the Harris plant in separate charges. Refined and desilverized lead is cast into anodes and sent to the electrolytic lead plant, in the southern part of the works. The Betts process is used in all important details, with rubber-lined iron cells, and with bor hydrofluoric acid electrolyte. Production, depending on the amount of bismuth-bearing lead, is limited to 300 tons per month. The cathodes are remelted in the Harris plant; the anode slime is cast into raw-bismuth anodes and refined by electrolysis. Production of electrolytic bismuth in 1930 was 16,400 kg.

Cadmium Plant, Sulphuric Acid Plant, Cuprous Oxide Plant—In the building used for electrolytic lead refining is also a small plant for leaching cadmium from flue dust and for electrolyzing the resulting solution. The sulphuric acid plant, shown in Fig. 6, was built in 1929-30. Besides pyrite, copper concentrate with 38 per cent sulphur is roasted. This is later sintered with raw concentrate in the Dwight & Lloyd plant. Two twelve-hearth 6-m. diameter Lurgi furnaces, 11.5 m. high, are used for roasting. Each furnace roasts 50 tons of concentrate from 38 per cent to 6 per cent sulphur in 24 hours. The furnace gas passes through a Cottrell plant to Glovers towers. Otherwise the plant operates after the Schmiedel-Klencke-Petersen method—that is, it has three tightly packed reaction towers, ahead of which are Schmiedel roller boxes. Total volume of Glover, reaction, and Gay-Lussac towers is 5,750 cu.m.—500 cu.m. for the Glover towers and 2,000 cu.m. for the Gay-Lussacs. At the left in Fig. 6 is the roasting plant with unloading plant; in the center are the Glover towers, and to the right the other towers. With two furnaces operating the plant has a daily capacity of 130 tons 60 deg. Bé. acid.

Another product is cuprous oxide, of which about 500 tons is produced annually. Cathode copper is dissolved electrolytically in sodium chloride solution with iron cathodes in diaphragms. The cuprous oxide sinks to the bottom of the cells and is washed, dried, and ground.

General—Other buildings on the premises comprise shops, warehouses, a laboratory in the two stories above the electrolytic silver plant, a local office—the main administration building is in the near-by city—and dwellings for the staff. Special mention must be made of the safety-first arrangements, which are given special attention on account of the danger of lead poisoning. Large, light lunch rooms, with running water, are provided. For the workers in the lead plant, special rooms are used for working clothes and other rooms for street clothes. Each worker must take a shower after removing his work clothes, before entering the room where his street clothes are. Opportunity for daily bathing is also provided for the other workers. The operation of a laundry permits frequent change into clean working clothes and provides towels, which are available in ample quantities.



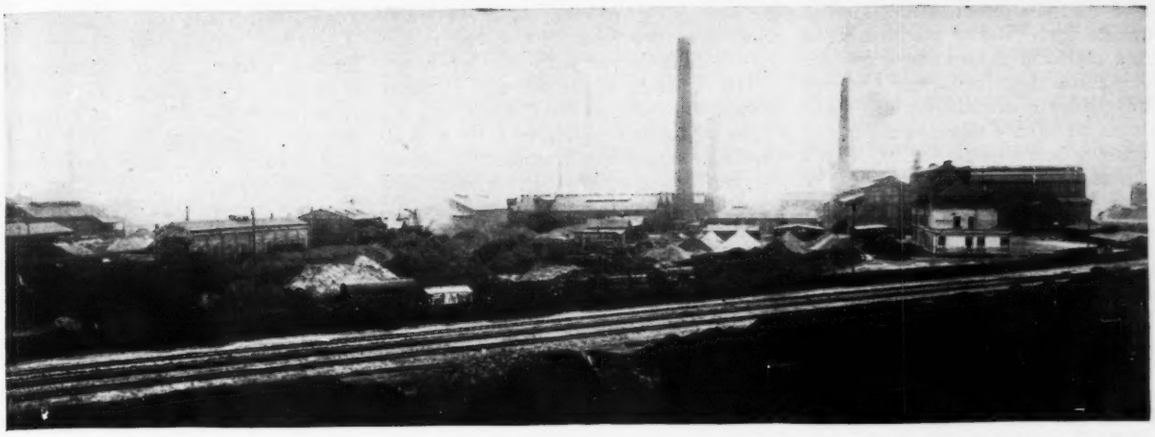


Fig. 1—General view of Duisburg plant, showing the smelter and the roaster building.

BERZELIUS ZINC SMELTERS

DIPL. ING. R. SEIFFERT DIPL. ING. ERICH KOCH

DIPL. ING. HERMANN MATTHIES

The Duisburg and Bensberg plants of Berzelius Metallhütten, with a combined annual capacity of over 40,000 metric tons of zinc, are typical examples of European retort practice. Modern byproduct plants produce annually about 70,000 tons of sulphuric acid.

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THE zinc smelters of Berzelius Metallhütten G.m.b.H., a subsidiary of Metallgesellschaft A.-G., Frankfurt a.M., are situated in Duisburg and Bensberg. The Duisburg smelter, the larger and most modern of the two, built in 1905-06, started in 1907. Duisburg was selected as the site for this smelter on account of the city's fine harbor at the entrance of the river Ruhr into the Rhine, with the best possible connection with the ocean ports Antwerp and Rotterdam; and also because of proximity to the Ruhr coal fields. Thanks to this favorable situation, the plant in Duisburg has been extended to cover an area of 500,000 sq.m., including the roasting plant, zinc smelter, and a tin smelter, built during the War, to which recently has been added an electrolytic tin plant. The situation is equally favorable for the disposal of the finished products. Sulphuric acid, one of the major products, used almost exclusively by the coke plants of the Westphalian and Dutch coal fields, is shipped in tank cars or in tank steamers. The large galvanizing plants and metal works of the Rhenish-Westphalian industrial zone, of which Duisburg is the hub, are the consumers of the zinc produced.

Roasting and Acid Plant

The zinc ores treated are almost all imported. Most of the steamship cargoes are transferred to barges in the Belgian port of Antwerp and taken up the Rhine to Duisburg. At the smelter dock the barges are unloaded into cars by a crane equipped with grab bucket. The cars are unloaded with steam cranes into a paved storage of 15,000 tons' total capacity, where the ores may be stored in separate piles, according to quality. From this storage the ore is taken to the bins of the roasting and sintering plant by aërial tramway. The raw blende is roasted in four Delplace furnaces, each with twelve compartments; one rabbled muffle furnace built on the same principle as the Liebig-Eichhorn furnace; and one mechanical Lurgi-Merton four-hearth furnace with ten shafts. The Delplace unit is a seven-hearth furnace, with gas-firing on the lowest hearth. This smelter was the first to build a furnace of this type in Germany. A circular Dwight & Lloyd sintering machine is operated in addition to the roasters.

Fig. 2 shows the roaster building with the Delplace furnace, the mechanical furnace, and the Liebig-Eichhorn furnace. This building is 90 m. long and 30 m. wide. Dump cars with green ore are elevated to a platform running the entire length of the building. The ore is dumped into storage bin *B*, which has a capacity of 100 tons to permit

repair of the lift without interruption in the furnace feed. Below platform F_1 is a second platform F_2 leading from the bin to the roasting furnaces. On this platform the ore is discharged into small dump cars, which are taken to the top of the furnaces and discharged. A Delplace-furnace compartment takes a charge of 400 to 450 kg. green ore. As the feed, consisting mainly of flotation concentrates, contains 8 to 12 per cent moisture, a certain amount is stored on top of the furnace, so that it enters the furnace in a dry state—a decided advantage in the use of the Delplace and the Liebig-Eichhorn furnaces. At other smelters where the furnace construction does not permit such methods, elaborate drying plants have been installed.

The ore is dumped by hand from the furnace top to the upper hearth, and spread out evenly over the entire surface. Then the charge is moved from floor to floor in the different compartments with long iron scrapers, and is finally discharged from the bottom hearth, through a grizzly, into cars and taken to the retort plant or to the sintering plant.

A Delplace furnace with a capacity of 12 to 15 tons of roasted blende per 24 hours requires a crew of four men per shift. Each unit of three furnace compartments has two fireboxes, so that a furnace of twelve compartments has eight fireboxes. The fuel—a well-baking, gaseous, bituminous coal—is spread on a small muffle, and coked. The coke is then dumped on a grate under the muffle, and is burned on this grate. A system of recuperators for preheating the air used for roasting as well as for the fireboxes is placed in the lower part of the furnace.

The sintering plant with the circular Dwight & Lloyd machine is shown in Fig. 3. This smelter was the first to use a machine of this type for roasting blende, utilizing the gases for production of sulphuric acid. It was installed in 1928 by Lurgi Gesellschaft für Chemie u. Hüttenwesen, a company closely associated with Metallgesellschaft. The furnace has an outer diameter of 9.5 m. and 30 sintering boxes, 1 m. wide. Total available roasting surface is 25 sq.m., of which 18.5 sq.m., or 73 per cent, is effectively used for roasting.

With the Dwight & Lloyd process Lurgi also took over the Rigg roasting process, in which process pre-roasted material with 10 per cent sulphur is taken from the regular roasting furnaces, preferably the mechanical furnace, and sintered and dead-roasted on the Dwight & Lloyd machine. The green ore and the pre-roasted material to be treated in the sintering plant are sorted in tramway buckets and elevated to bins B, the capacity of which is 250 tons. The bins discharge to a cable tramway feeding the Raps mixer M. This tramway is equipped with a scale, to permit the weighing of the different components of the feed. From the mixer the ore is delivered with belt conveyors to bin B_3, from where the mix is taken on belt conveyors to the Dwight bins B_5.

Before the mix is charged to the D. & L. machine is passes a trommel T, where it is moistened with water. A small oil-fired furnace, near the feed end, ignites the ore bed. The finished sinter is removed with a scraper into a toothed roll at the discharge end, and the crushed sinter is taken by bucket elevator F to bin B_4. From this bin the sinter is drawn into special cars and trammed to the smelter. The entire sintering plant, including transportation, crushing of the sinter, and fans for handling the gases, has a daily power consumption of about 1,000 kw.-hr. and a crew of five men per eight-hour shift. Production for the D. & L. machine is about 100 tons of sinter in 24 hours. The annual capacity of the entire roasting plant is about 45,000 tons raw blende.

Gases from all the furnaces, as well as from the Dwight-Lloyd plant, are used for the production of sulphuric acid by the chamber process. Available chamber capacity is 26,400 cu.m. Four systems of 4,600 cu.m., and one system of 8,000 cu.m. are used, with eight Glover towers, 12 m. high and 3 m. in diameter, and 12 Gay-Lussac towers, 14 m. high and 3 m. in diameter, designed and built by Lurgi. The chambers are of steel construction, 15 m. high and 5.5 m. wide, arranged so that the steel members for hanging the sides of the chambers are connected with the columns and the roof trusses, a construction, patented by Lurgi, which has proved advantageous.

The acid plant is joined directly to the furnace building, an arrangement which is of special advantage, as the furnace gases reach the Glovers at a high temperature. Cast-iron fans and pipes are used to carry the roaster gases from the sintering plant to the acid plant. In the chamber system, lead pipes and fans are used. Piston pumps of the Kestner type are used for the transportation of Glover and nitroso acids for washing the towers, and centrifugal pumps for acids below 57 deg. Bé. Only part of the acid can be made of the 60 deg. strength required for shipment; the remaining weak acid is concentrated in lead pans. For the storing of 60-deg. acid, tanks with a total capacity of 3,000 tons are available; 50 tank cars are used for shipment. The present plant has an annual capacity of 45,000 tons of 60 deg. Bé. acid.

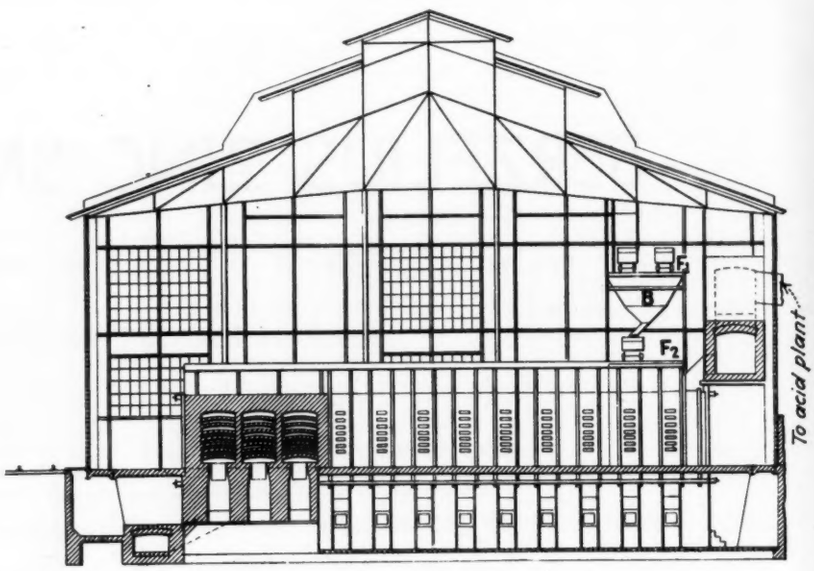

Fig. 2—Plan of roaster building, Duisburg

The Zinc Smelter

Ore-mixing Plant—Roasted blende is taken to bins at the zinc smelter in special dump cars which are sampled and weighed at a special station. An aërial tramway runs from the bins to the mixing plant. Ore and coal for reduction, amounting to about 38 per cent of the charge, are delivered by an elevator to a Raps mixer, and the mixed charge is taken to the zinc furnace in electric cars. An anthracitic low-volatile coal, with 8 to 9 per cent ash and 8 to 9 per cent volatile matter, is used for reduction.

Furnace Building—The smelter building is 200 m. long and has eleven zinc furnaces, placed crosswise in a row,

10 to 12 in. apart. At one end of the building are the ore mixers, and the coal storage and mixers and conveyors are at the other. The coal is elevated and dumped on a belt conveyor extending the entire length of the building and delivered to the bins for the gas producers, which are placed as near the zinc furnaces as possible in order to reduce heat losses to a minimum. Each zinc furnace has its own gas producer, partition into the adjoining furnace chamber (*H*); here the flame takes an upward path into the channels over the furnace roof, and is finally discharged through the preheater, where as much as possible of its heat is given off to the brickwork. In this unit, the preheater is designed large enough to reduce the temperature of the gas to 300 deg. C. The arrangement of the burners in the furnace roof has the advantage over other systems that the burner and gas mains cannot be destroyed by liquid slag or in the event of muffle breakages.

Slag is collected at the bottom of the furnace, where it is exposed to the highest temperature during the last hours of distillation and thus kept molten, so that it may be removed through special holes. The massive foundation

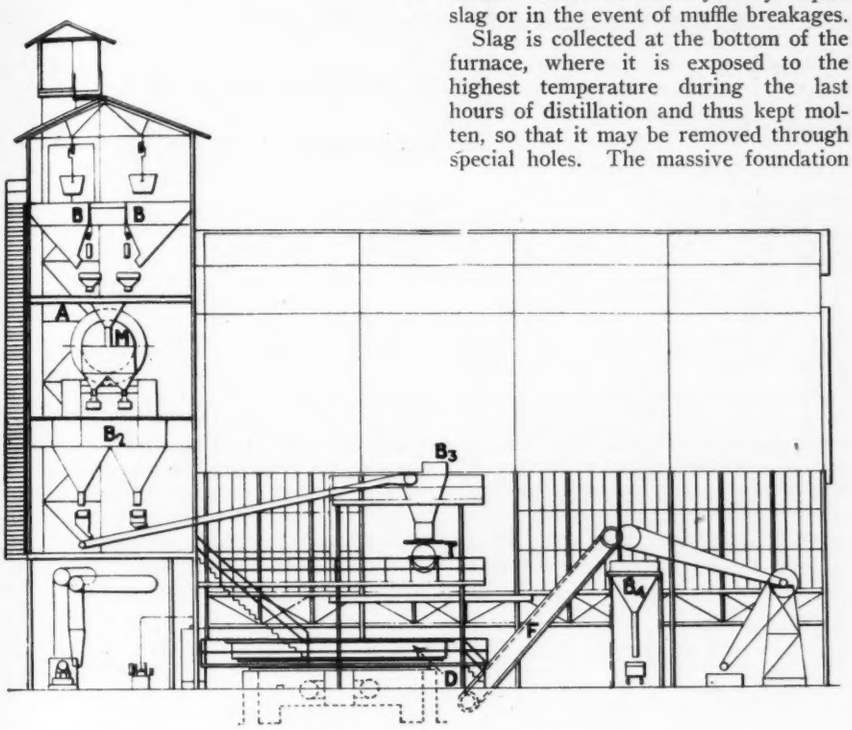

Fig. 3—Sintering plant at Duisburg

as centralization of the heating plant has not been found practicable.

Zinc Furnaces—Details of a furnace are shown in Fig. 4. It contains 216 muffles, 108 on each side, arranged in three rows, each of 36 muffles. The muffles, of oval cross-section, 1.85 m. long, are supported at the ends by fireproof blocks, with the central part free.

The furnaces, which are operated after the regenerative principle with preheating of gas and air, differ from regular construction in the respect that the heat chambers (*F* and *G*) are placed at the head of the furnace. These chambers are ribbed shafts and have the advantage that they may be cleaned easily by blowing or sweeping with steel brushes hung in chains. In this type of furnace the slit-shaped burners (*J*) are placed in the furnace roof, and gas and air are conveyed to this point through the gas and air mains (*K* and *L*) on top of the furnace. The flame thus plays downward past the muffles, passes through the small openings (*M*) at the base of the middle of the furnace permits a solid middle wall, which serves as support for the two small furnace roofs. These small furnace roofs, only 2 m. wide, have the advantage of being more durable than the larger, 4.5 m. width roofs normally used. Long life has been the important consideration in the construction of the furnace, and this object has been attained. Carefully built furnaces made of good silica material have served for six years and more.

A further advantage of the furnace lies in the easy regulation of the flame. By varying the slit of the burners, and of the openings through which air is admitted, the flame may be regulated to any length in the same manner as a Bunsen burner, and an even heat of the entire furnace is thus obtained. Each row of muffles can therefore be charged equally, with the assurance of an even removal of zinc from the charge.

The condensers, which are removable, have an oval cross-section corresponding to that of the muffles, and are bottle shaped. They differ in construction from the American type by having a sheet-iron prolong at the mouth, for collecting the blue power.

Especially worth mention is the method of removing the gases from the prolongs. They are collected in a sheet-metal shaft at the base of the furnace, and led through pipes above the furnace into a double stack, 80 m. high, consisting of an outer stack of brick, of 5 m. diameter, in which is placed a concentric sheet-iron stack, shorter than the brick stack, and acting as an injector. The furnace gases, having a temperature of about 300 deg. C, enter the inner stack, thereby causing a suction in the outer stack, partly by the injector action and partly by the heat transmitted through the sheet iron. Thus the gases are forced high up in the air, where they are thoroughly diluted. A stack of this type serves three furnaces. A crew of twelve men is required for a furnace during the charging period, each man handling eighteen muffles. One worker and a fireman on each shift take care of the furnace and tap the zinc.

The charge, governed by the zinc content of the ore treated, is generally about 12 to 13 tons, with a zinc production of 6.5 to 6.8 tons. With the smelter operating at full capacity, the yearly production is about 25,000 tons of zinc. About 8 to 9 per cent of the zinc in the charge is lost. The muffle residue, 3 to 5 per cent zinc, is sent to the waste pile if the content of lead and precious metals does not warrant further treatment. In the latter case the residue is washed in a concentrator adjacent to the smelter, and the concentrate is sent to the company's lead and silver smelter at Braubach.

Gas Producers—Morgan and Thyssen gas producers of 2.5 m. diameter are used. Some of these have stationary grates; others have revolving grates. As previously stated, each furnace has its individual gas producer, placed as near to the furnace as possible. A mixture of coal gas and anthracite nut No. 4 is used, both obtained from the near-by Ruhr district. They are of the following analysis:

Gas coal: water, 2 to 2.5 per cent; ash, 10 to 11 per cent; volatile matter, 30 to 31 per cent; thermal value, 7,200 to 7,300 calories. Anthracite nut No. 4: water, 4 to 5 per cent; ash, 6.5 to 7 per cent; volatile matter, 8.5 to 9 per cent; thermal value, 7,800 to 7,850 calories. The gas produced contains 3 to 3.5 per cent carbon dioxide, 0.2 per cent C_mH_n, 1 per cent methane, 27 to 28 per cent carbon monoxide, and 10 to 11 per cent hydrogen. It has a lower thermal value of 1,300 calories and 1,500 calories including the contained heat. The air required for gasifying the coal, produced with Root blowers, is 2.8 standard cubic meters per kilogram of coal. To this must be added 0.25 to 0.3 kg. steam, produced in small boilers heated by generator gas. Worth mentioning also is the Morgan mechanical coal feeder,

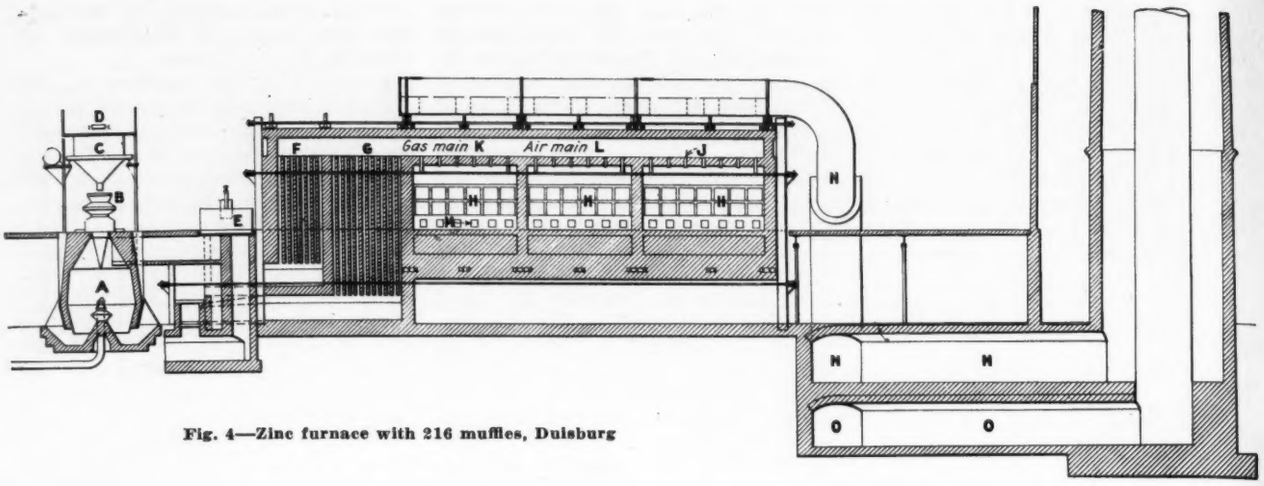

Fig. 4—Zinc furnace with 216 muffles, Duisburg

A. Generator
B. Coal feeder
C. Coal bin
D. Coal conveyor
E. Trommel regulating gas flow
F. Preheater for gas
G. Preheater for air
H. Furnace chamber
J. Burners
K. Gas main
L. Air main
M. Opening between two adjoining chambers
N. Flue for condenser gases
O. Flue for furnace gases

which has not gained extensive use but which serves well in this installation. It permits an even feed of coal, resulting in a favorable coal consumption. which amounts to 80 to 85 per cent of the ore treated. Included in this figure is also the coal used for generating the steam for the gas producers.

Muffle Manufacture — The fireproof materials required in the smelter, of which the muffles and condensers are the most important, are produced in a shop adjacent to the furnace building and connected with it by a covered passage. The shop has drying space for 18,000 muffles and the same number of condensers.

For production of muffles a German clay of the following composition is used: Silica, 50 to 55 per cent; alumina, 30 to 34 per cent; ferric oxide, 2 per cent; lime, 0.4 per cent; and alkalies, 0.4 per cent. The loss in ignition is 9 per cent; Seger cone, 33.

High-silica grog is used as an admixture, mixed with coke dust to increase the refractory qualities and to counteract the corrosive effect of the slag. The coke is reduced to below 1 mm. size in a ball mill, and the clay and grog are ground in a Vapart mill, to 0.5 mm. The ground material is discharged into a horizontal kneading trough, to which at the same time the required water is added (about 15 per cent.). After two days' storage and repeated kneading, the mass is taken in a bucket elevator to a vertical kneading receptacle, where it is moulded into cylindrical ballots of the same diameter as the cylinder in the muffle press. The press used is the one commonly employed in Germany, made by Mehler & Company, in Aachen, working at 220 atmospheres' pressure, and producing 22 to 25 muffles per hour.

The muffles are placed in drying rooms equipped with wooden screens, where they remain for the entire drying period, usually about two months. Under the wooden floor screen steam pipes are placed, which are used after fourteen days' air drying. The temperature is gradually raised to 60 deg. C. A slow rise in temperature is essential, as the muffles require careful drying, on account of their acid composition. To prevent the burning of the small particles of coke, the muffles, before use, are also given a low-fusing glaze of clay, glass, and soda. Clay of poorer quality mixed with muffle fragments in the ratio 40 to 60 is used for condensers. Grinding and kneading equipment is the same as used for manufacturing muffles. A press of special construction, designed at the plant, produces 600 condensers per hour.

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BENSBERG SMELTER

The Berzelius zinc smelter, in Bensberg, near Köln, the oldest zinc smelter of Metallgesellschaft, was erected in 1853 near the zinc blende and calamine fields of Bensberg and Frankenforst. Lignite and fireclay were also found in the vicinity. These raw materials, however, later proved unsuitable for the smelter. After several failures the smelter was taken over by the Berzelius company, in Bensberg. In 1872, the name of the company was changed to Bensberg-Gladbacher Bergwerks- und Hütten A-G. "Berzelius." In 1882, a sulphuric acid plant was added, operated by the chemical factory Rhenania. An amalgamation with Metallhütte Duisburg was accomplished in 1921, and the name was changed to "Berzelius" Metallhütten A.G. Finally, in 1926, Metallgesellschaft assumed control, forming "Berzelius" Metallhütten —G.m.b.H. Lack of ore forced the mines at Bensberg to close down in 1925, and the plant is now operating as a custom smelter.

The smelter, with an adjoining property of about 125 hectares, is situated on the Cologne-Hoffnungsthal railroad between Bergisch-Gladbach and Bensberg. The ore is transported from Antwerp in Rhine barges as far as Mülheim, and from this point by railroad. Coal is obtained from the Rhenish lignite fields at Köln and from the Ruhr district; and clay, from German and Belgian mines. The incoming raw materials are unloaded with two steam cranes.

Roasting—Equipment comprises four twelve-compartment Delplace furnaces, three with seven hearths and one with six; and one four-hearth Lurgi-Merton furnace with ten shafts. All furnaces are gas-fired as at Duisburg. The Lurgi-Merton furnace is fired with gas made from lignite briquets, produced in a Heller generator. In the Delplace furnaces, about 10 kg. of sulphur is eliminated per 24 hours per square meter roasting surface; in the Lurgi-Merton furnace, 17 kg. About 23,500 tons of raw ore is treated yearly. Raw blende is fed to the furnaces in dump

buckets handled by a crane running over the furnaces. The roasted blende is also carried in dump buckets over a scale to storage bins. Before the roasting, the coarse blende is crushed to 2 mm. in a Chilean mill. A two-chamber Cottrell installation with plate electrodes is used for treating the roaster gases from the Lurgi and Delplace furnaces.

Acid Plant — Two chamber systems (one of wood with five chambers, and one of steel, as in Duisburg, with four chambers) are near the roasting furnaces. Their capacity is 7,000 and 7,300 cu.m. chamber volume, respectively. The installation consists, in addition, of four Glover towers with a total volume of 286 cu.m. and seven Gay-Lussac towers of 530 cu.m. total capacity. Two pan concentrators deliver 7,000 tons of 60 deg. Bé. acid per year. Acid is pumped with Forster piston pumps and centrifugal pumps of the type used in Duisburg. The acid plant has a total annual capacity of 24,000 tons of 60 deg. Bé. acid.

Zinc Smelter—Bins are provided between the roasting and the mixing plants for the roasted blende, which is taken from the bins in dump buckets, over scales, to a Raps mixer via an automatic screening and crushing plant, reducing to 10 mm. particle size. The material is mixed with anthracite, as in Duisburg, and then taken in electric cars to the retort plant.

Furnace Buildings—Furnace building No. 1 has eight Siemens regenerative furnaces placed across the building, each with 108 muffles. An annex has a Duisburg furnace with 216 muffles. Furnace building No. 2 has six Siemens furnaces.

Zinc Furnaces—The construction is shown in Fig. 5. The furnace contains 108 muffles, 54 on each side, arranged in three rows of 18 each. These muffles are of oval cross-section, 1.85 m. long, supported at the ends only.

Four recuperators for gas and air under the muffles, 1.75 m. high, have a lattice work of stone so arranged that they may be cleaned with steam pipes from the narrow end. Vertical flues through the roof are placed in the flame canal, which also serves as a collector for the slag. Each side of the furnace has a common flame canal about the gas and air chambers. The roof of the canal, made from Dinas material, is pierced with a sufficient number of burner slits so that each vertical row of muffles is surrounded by two walls of flames. Regulation of the flame is accomplished by slabs of fireproof stone, acting as dampers in the vertical gas canal. The flame has an upward sweep on the gas side, passes through the free passage between the center wall and the roof, and is drawn downward into the recuperators on the discharge side. In the individual rows of muffles, the heat

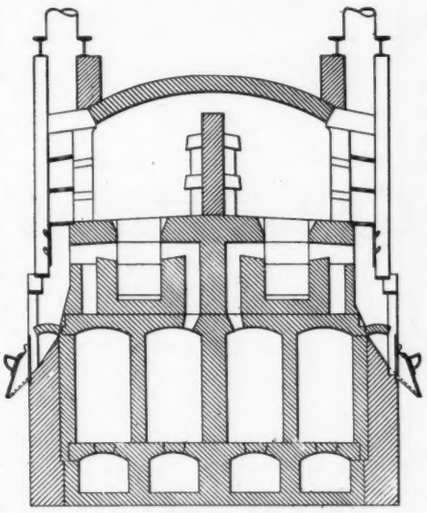


Fig. 5—Zinc furnace with 108 muffles, Bensberg

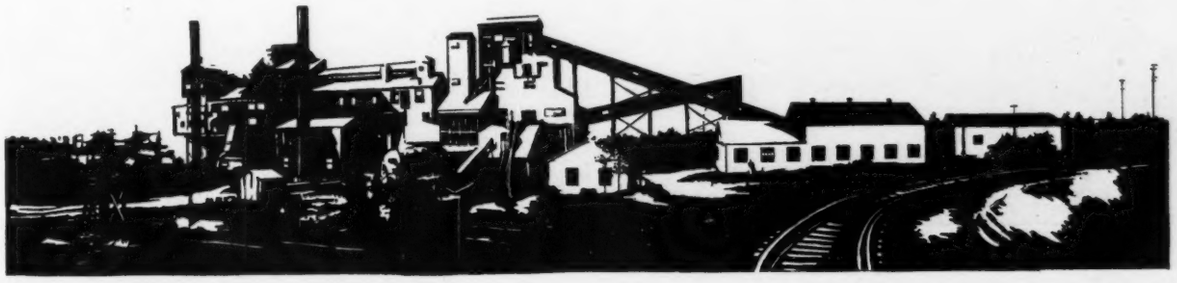
is even and the fuel is well utilized. The gas leaves the recuperators at a temperature of about 300 deg. C.

The condensers are of the same type as at Duisburg. All gas from these is taken in sheet-iron stacks running through the roof of the building. Six men are required for handling a furnace with 108 muffles. From 6 to 6.5 tons of ore from the Delplace furnaces, with 53 per cent zinc, is handled daily, producing 2.8 to 2.9 tons of zinc. Maximum annual production is 18,000 tons of zinc. The zinc loss is between 11 and 12 per cent. Muffle residue with 3 to 5 per cent zinc is sent to the waste pile. Valuable lead and silver residues are washed to remove excess coal, and sent to Braubach lead smelter for further treatment.

Gas Producers—The gas used is produced from Rhenish lignite briquets analyzing as follows: carbon, 54.5 per cent; hydrogen, 4.2 per cent; oxygen, 20.4 per cent; nitrogen, 0.5 per cent; sulphur, 0.4 per cent; moisture, 15 per cent; ash, 5.0 per cent; with a thermal value of 4,800 cal. Specially constructed generators 1.65 m. in diameter, with round shaft and stationary grates, and Bamag generators, 2.6 m. in diameter, with revolving grates, are used. The generators are operated with bottom draft, and steam is added. Gas analysis is as follows: carbon dioxide, 5 per cent; carbon monoxide, 30 per cent; methane, 2 per cent; C_nH_m, 0.4 per cent; hydrogen, 13.6 per cent; nitrogen 49.0 per cent, thermal value 1,450 to 1,500 cal. The steam added is generated in a central steam plant. Coal consumption, including that needed for steam production, is 115 to 120 per cent of the weight of ore treated.

Five gas-fired duplex furnaces are used for drying muffles; each half furnace, holding 30 to 40 muffles, may be heated individually.

All fireproof material except the Dinas stone is produced locally. The muffle shop, built between the two furnace buildings, is arranged and operated as is the one in Duisburg; condensers, however, are made by hand. Drying chambers for 10,000 muffles and 12,000 condensers are available.



Exact and thorough, German research has always commanded world-wide respect. The scientific and technical personnel of Metallgesellschaft illustrates in a striking manner the fact that intelligence and creative ability are among the important raw materials of modern industry.

Lurgi House in Frankfurt a. M.

RESEARCH AND DEVELOPMENT WORK

THE growing importance of research has forced Metallgesellschaft to pay increasing attention to the development of its laboratories. On account of the wide field of activities, from smelting ores to fabrication of metals, all problems could not be handled in one laboratory. A metal laboratory was added to the analytical laboratory during the War; later, laboratories for technical and physical chemistry were provided, and most recently a laboratory for colloid chemistry was added to the research equipment. A heat-technology department, to advise the laboratories and plants, and to develop new processes within the scope of the company's activities, has also been established. The growth of this activity is best illustrated by the fact that whereas in 1913 eighteen persons only were engaged in research work and a total of 81,549 marks ($20,000) was expended, the corresponding figures for the year 1929 were 155 men and 1.3 million marks ($325,000). During the same period the number of patents held by the company increased from 114 to 700.

All laboratories are combined under one technical secretariat, directly responsible to the board of directors. The patent department and the library co-operate closely with the laboratories in matters coming under the jurisdiction of the secretariat. In the early days, two of the laboratories were situated outside the administration building. On account of the importance of a close contact between the directors and the men in charge of the laboratories, the physical chemistry and the colloid chemistry laboratories were moved to the adminstration building in 1930, and the technical and physical chemistry laboratories were combined. At present the floor space occupied by the laboratories amounts to about 3,000 sq.m.

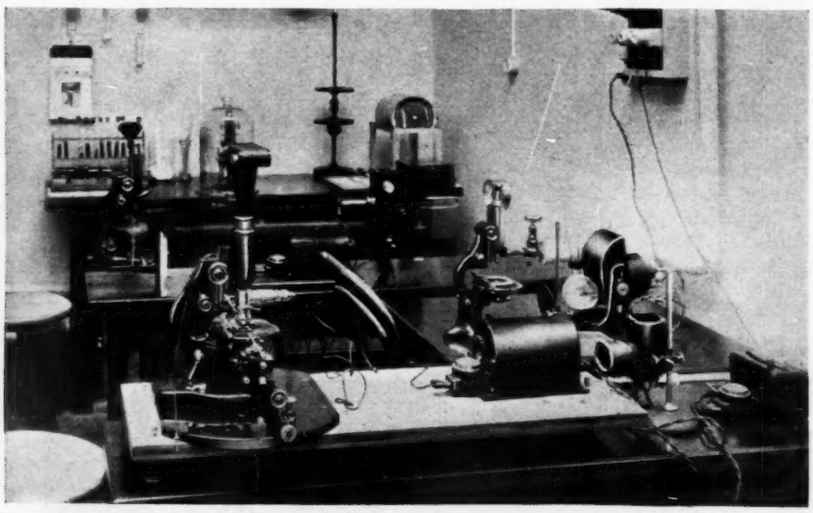


Fig. 1—Optical instruments in colloid-chemistry laboratory

The arrangement of the rooms fills all the demands that may be placed on a modern laboratory. All power, air, gas, and steam lines are made easily accessible, and good ventilation is assured by a corridor separating the individual rooms. A central electric substation produces direct-current power for electrolytic purposes, and alternating current for electrothermic experiments up to 120 kva. All transformers and converters are placed in a separate room, completely separated from the experimental rooms. The optical room in the laboratory for colloid chemistry (Fig. 1) is equipped with modern instruments, among which are a micro-manipulator and a ultropac microscope. Special apparatus is built in a central shop with a glass-blowing department.

The functions of the laboratory comprise: (1) Advising the company's own plants regarding operating problems; (2) advising the marketing companies in connection with their process market-

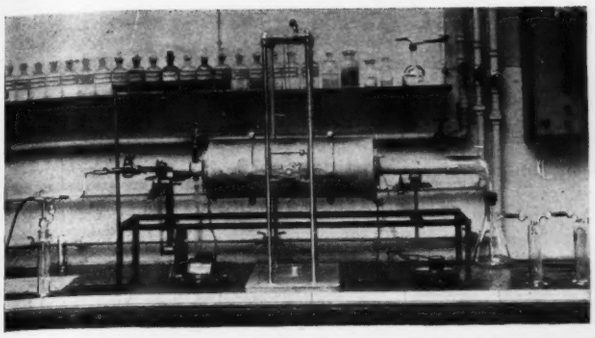


Fig. 2—Small laboratory furnace with 25 grams' hourly capacity

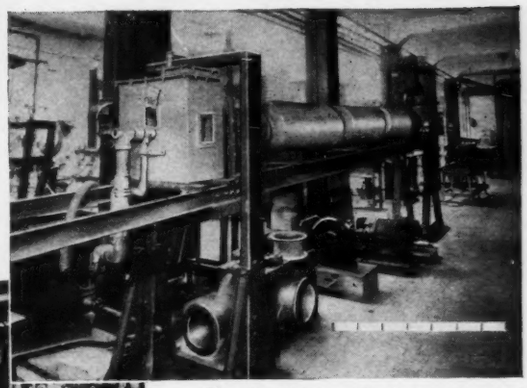


Fig. 3, above. First experimental furnace with 25 kg. hourly capacity

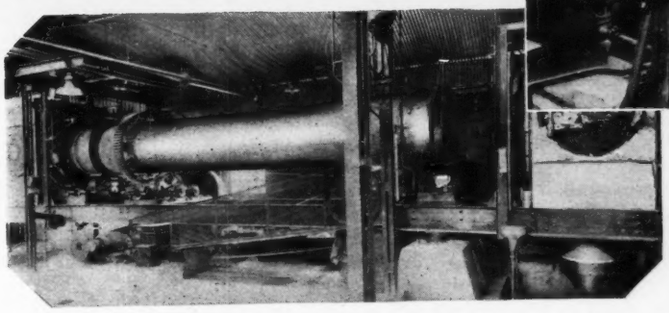


Fig. 4—First commercial installation, treating 250 kg. per hour

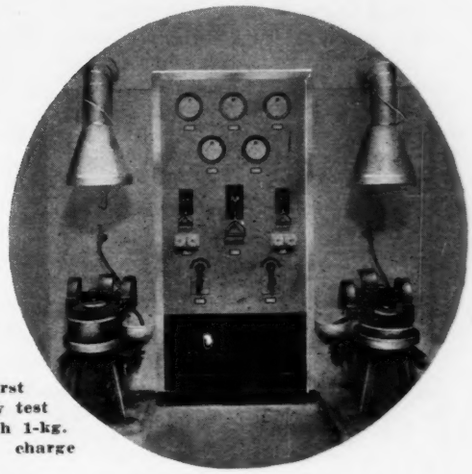


Fig. 5—First laboratory test with 1-kg. charge

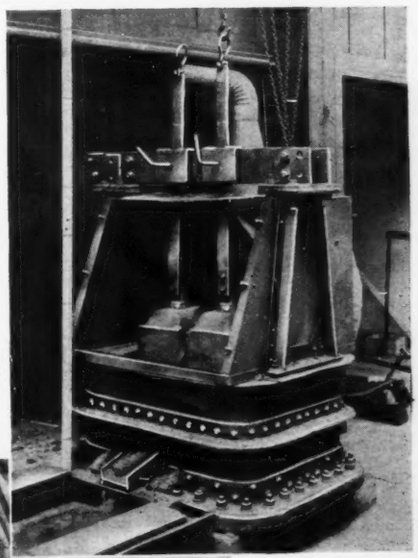


Fig. 6 — Second laboratory test with 10-kg. charge

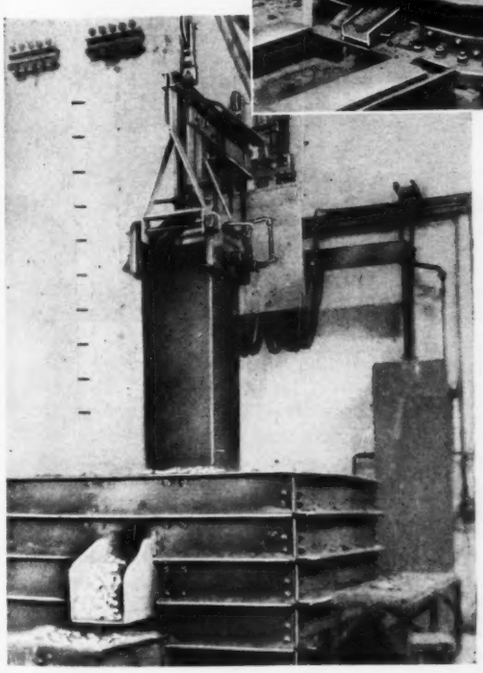


Fig. 7—First commercial installation with 250-kg. charge

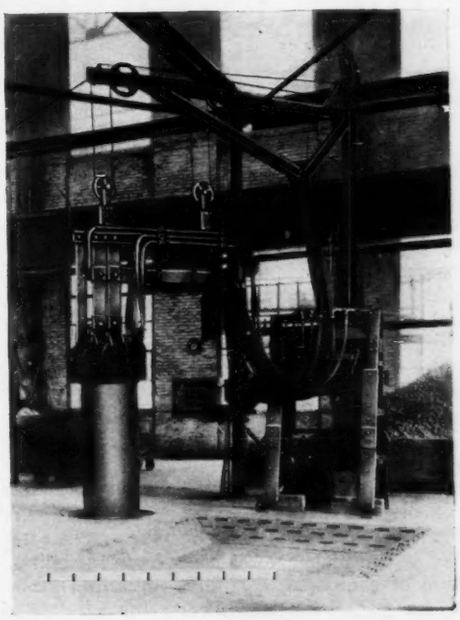


Fig. 8—Final installation with 1,000-kg. charge

ing (the Lurgi companies; discussed later); (3) testing and developing inventions offered from outside sources; (4) research to improve known processes and to provide new related production possibilities.

A guiding rule in all experiments is first to examine every new idea from a theoretical point of view to determine if economic advantage is offered in addition to the technical improvement suggested. Only when such a possibility exists is work started, and then on the smallest (gram) scale. If the tests proceed satisfactorily, experiments on a larger (kilogram) scale are undertaken. Two large rooms are used for this work. Small apparatus, as similar as possible to actual operating equipment except in size, is used. As far as possible, estimates of the probable cost of the process are made in these tests.

Only when the process gives satisfactory results on this scale is a test plant on a semi-technical scale built. Whenever possible, this is built at the plant where the process will finally be adopted. The same men conduct a test from start to finish, from the gram experiment until the first unit has been incorporated as an operating unit of the plant. To carry the tests through three stages in this manner, at an increasing scale, permits greater economy and minimizes the possibility of having to abandon a process for economic reasons after it has reached commercial development. To assure this, the conditions of the tests must be made to resemble actual conditions as nearly as possible.

As an illustration of this procedure may be cited a process for recovering a metallic compound from a low-grade material. From theoretical considerations, a revolving furnace first appeared most suitable. The first laboratory tests were conducted in a small electric furnace, consisting of a slightly inclined tube passing through a cylindrical muffle. As the results showed that the reaction took place according to the theory advanced, and the output also proved satisfactory, a small revolving laboratory furnace was built. This gave results that checked closely those obtained in the gram test. A revolving furnace based on the results obtained was then installed in the plant. Almost from the start this installation gave results corresponding to those obtained in the smaller furnace. Figs. 2, 3, and 4 illustrate the three stages in the development of this process.

Figs. 5, 6, 7, and 8 illustrate the development of an electric-furnace process from gram scale to commercial operation, treating thousands of kilograms. The test deals with the electrothermic production of an aluminum-silicon alloy. Fig. 5 shows the gram test in a small electric resistance furnace (Tamman furnace); Fig. 6 a laboratory furnace, constructed after the same principle as the furnace finally used. Fig. 7 shows the first installation in the plant, and Fig. 8 a large furnace, which now, with five other furnaces of the same type, installed in a large furnace building, is producing the alloy.

This method has proved successful. On account of the small cost of a gram or a kilogram test, the expense involved is of secondary importance. Changes in the apparatus are easily accomplished in a minimum of time. Thus the determining factors of any process and the most favorable operating conditions are easily established, and few unexpected results are encountered later, when the process is transferred to a commercial scale. The danger of building large experimental plants, which later are found of no value on account of serious mistakes, discovered too late, is minimized by the method here detailed.

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PROCESS DEVELOPMENT AND PLANT CONSTRUCTION

Carbonization plant treating 400 tons of lignite daily

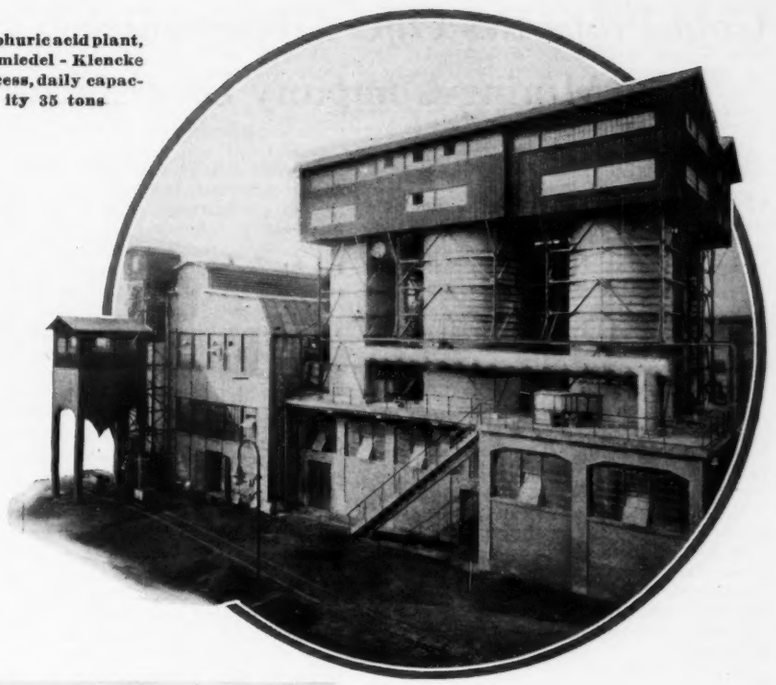
THE division of Metallgesellschaft concerned with process development and construction of equipment is centralized in the Lurgihaus, in Frankfurt, the three branches of which are fully controlled by the parent company. An outline of the foundation and development of this organization must precede the description of its scope and activities. Metallgesellschaft's fourfold activity in copper, zinc, tin, and lead metallurgy; the interest in metal-fabricating plants; the opportunities offered by the trade in ores and pyrites—in addition to the sale of metals, the original activity—made the establishment of a branch for the development of technical processes and for construction of equipment desirable as long as 25 years ago. The technical and scientific results obtained by the cooperation between headquarters in Frankfurt and the associated plants were transferred to a third concern by granting licenses. Work on processes was also undertaken, which, although of no direct interest to any single unit of the organization, still came under the ever-extending scope of the steadily growing, technico-scientific enterprise. Neither was this work limited to the company's own processes: It drew from outside inventors and men acting as consultants to the company. In this way the present organization grew up.

In the technical secretariat of Metallgesellschaft a laboratory staff of about 155 is occupied with the development of new processes. As soon as a process has been introduced in the plant on a commercial basis, after passing through the various experimental stages in the laboratory, the duties of the technical secretariat cease, and the process is transferred to one of the three branches of the Lurgi organization, for commercial utilization and further develop-

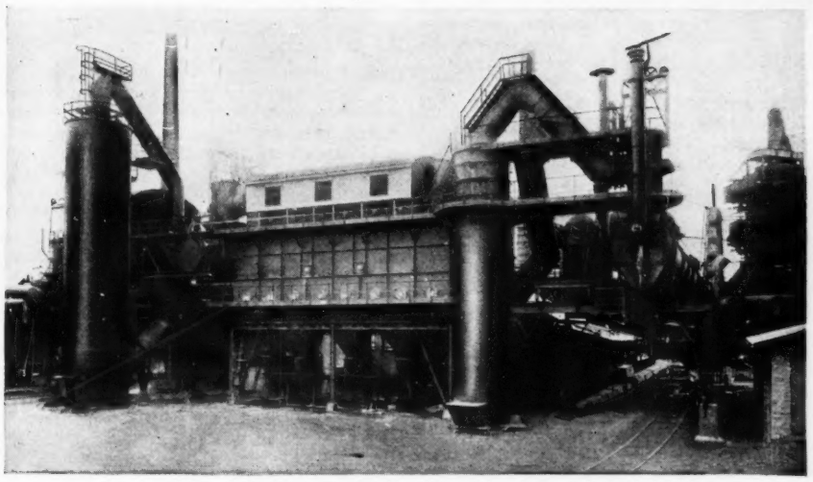
ment. In so doing, care is taken that an intimate contact is retained between the secretariat and the concerns using the process, with interchange of all new scientific data and technical improvements.

The duties of the three branches do not merely comprise a commercial exploitation of the processes by issuing licenses or by constructing new plants, or by sale of equipment; the Lurgi companies study the possibilities for further development of the various processes, and keep those using the processes informed of all progress made. A staff of over 350 is occupied thus. Their field of activity is divided as follows:

The Lurgi Gesellschaft für Chemie u. Hüttenwesen G.m.b.H (Lurgi Company for Chemistry and Metallurgy) builds furnaces for roasting ores and pyrites, of the Lurgi and the Wedge type, and Dwight & Lloyd sintering plants for treatment of sulphide and oxide ores



Sulphuric acid plant, Schmiedel - Klencke process, daily capacity 35 tons



Electric precipitation plant for treatment of blast-furnace gas

and for agglomeration of flue dust. Special methods for sintering ores are the Rigg and the Overpelt processes. Lurgi has also developed a method for blast-roasting pyrites. In the metallurgical field this branch of Lurgi handles processes for copper and zinc leaching; the Harris lead-refining process; the Waelz volatilization process for treatment of lead, zinc, and tin ores and residues, developed jointly with Krupp Grusonwerk; the Gröppel revolving furnace; and various types of mixers used in smelting operations.

Another important activity of Lurgichemie is the construction of sulphuric acid plants, operating by the company's own intensive process, and by different contact processes, of which the Aussig process is the most important. Vanadium or platinum contact masses are used as the specific condition may demand. The fiber industry is supplied with roasting furnaces and digester feeders, of the Fresk and Svensson type. Lurgi also handles the Nordengreen phosphoric acid process and the DuPont de Nemours nitric acid process.

The associated company, Lurgi-Apparatebau-Gesellschaft m.b.H. (Lurgi Apparatus Building Company), first introduced the Cottrell-Möller system for electric gas precipitation in Europe in 1912. It co-operates closely with the overseas Cottrell companies. After using the apparatus for purification of roaster gases and in other metallurgical processes, Lurgi also introduced the method for use in different industrial applications, as in the manufacture of lignite briquets, in cement manufacture, and for removal of tar in generator gas and gases of similar nature. Of special importance is the removal of dust from blast-furnace gas so that it may be used directly in gas engines. Treatment of gas of all types for removal of dust is becoming increasingly important, especially of stack gases from large power plants.

The third branch of the Lurgi organization, Lurgi-Gesellschaft für Wärmetechnik m.b.H., devoted principally to application of heating processes in chemical and allied fields, has developed a carbonization process for lignite. Associated problems, such as briquetting lignite coke, recovering benzol and tar, are also treated. Distillation plants built by Lurgi are operating satisfactorily in America. At present a large plant is also being built in New Zealand. Methods have been developed for evaporating liquids, distillation, and refining oil. The Krause system for drying and dispersing is another important Lurgi activity. Lurgi is also cooperating with the important European producers in technologic research on activated carbon.

The outline here given includes only the more important activities of Lurgi. To complete the picture the fact must be mentioned that the special alloys developed in the metal laboratory of Metallgesellschaft-Silumin, a special aluminum alloy for castings, is used in increasing quantities in the automotive industry. A lead alloy used for bearing metal has been introduced on the German National Railways on a large scale, replacing the commonly used alloys.

During many years of fruitful activity the organization, with its increasing number of branches, has developed a tradition based on the fundamental idea that technical excellence only, resulting from a close coordination of pure science and practical execution, offers promise of lasting success.

Gold Properties Offer Opportunity for Mining Company Diversification

To the Editor of "E.&M.J.":

Only one metal of major importance has increased in value. I refer to gold, which is of negligible use except for currency and as a basis for credit, and which, after having depreciated in terms of commodities steadily for the last sixty years, and with particular rapidity from 1914 to 1920, has since been staging a comeback, the future extent of which cannot easily be foretold. Hence, the producing gold-mining companies are prospering; costs are down, earnings have increased, and the dividends they pay mean more to the stockholders.

Aside from producing and developing mines, gold deposits can be classed under one of two headings: (a) abandoned mines, and (b) prospects. In both cases they can only be brought to a productive stage by the expenditure of money, some of which must be risked and cannot be classed as a mining investment.

Considering the abandoned mines that dot our Western states, but which have been idle since the 70's, 80's, or 90's, it first becomes important to inquire into the cause of their inactivity. Some of these mines quit because they could not produce and market gold for less than $20 per ounce under the then-existing conditions, and in them more or less low-grade ore remains. Some petered out entirely. Some worked down to water level and could not afford the extra cost of pumping. Some reached sulphides or refractory ore from which the gold could not readily be extracted before the advent of cyanide treatment, when lack of transportation and local smelting facilities made it unprofitable to ship a gravity concentrate. Many of these old properties are now in the hands of estates whose trustees have no authority to reopen them; some are in litigation and nearly all are in such condition that to readily measure and sample the remaining ore is impossible. Their assay maps (if any were made), records, and reports have been lost or destroyed. Placer workings were sometimes stopped by anti-débris restrictions, which have since been repealed or modified; others failed for lack of water or lack of funds to bring the water from long distances.

The prospects are always with us—a favorable geological condition, the proximity of a good producer, some surface values or indications that values will come in with depth, and someone must decide if they are worth the cost of exploration and development, and money must be gambled to prove or disprove their worth. The mining adventurer who was once so ready to take a chance of this kind has now all but disappeared, and there is a wide and ever-widening gap between the prospector with his staked claims, a few picked samples from the surface, and unlimited faith, and the hard-boiled mining company or syndicate that demands ore in place for its engineers to sample and measure before capital will be furnished for equipment and development, and then only on terms that must be strictly of its own making. This gap is only partly and not always creditably filled by the promoter or the small company that tries to sell stock locally or through a large mailing list of possible investors.

We have today many new tools for the discovery and treatment of ores which were unknown forty or even twenty years ago. Economic geology has taken great strides, and predictions of depth and value can be made on a firmer basis. Geophysical methods of exploration, which are making rapid progress, enable us under certain conditions to look into the ground and at least determine the location of certain formations and types of ores. Drilling is cheaper and more reliable. New and more economical methods of mining have become standard practice. Costs of producing power and pumping have been decreased. Roads and railroads have brought the mines near to the treatment plant and markets. Even the airplane assists under special conditions to prospect and develop remote regions. We no longer shun a gold ore which is not "free milling." Cyanide, flotation, and other methods have been firmly established, and lead and copper smelters welcome a gold-bearing ore or concentrate, and pay for almost 100 per cent of its value with low toll charges for treatment. Labor was never so eager to find continuous employment, and in my humble opinion it is far better to give men steady work at a reduced wage than to lay them off entirely or employ them four days a week on a scale which prevailed two years ago when food at least was 20 per cent more expensive than it is today.

Never before could gold mines be developed or operated so advantageously as at present. Many old mines that could not have been worked with profit from 1890 to 1929 might produce with a fair margin of profit under existing conditions; and many properties are much more attractive today than at any time in the past. The price of gold does not change except in relation to its purchasing power, and no one seems to fear that gold will be demonetized during the lifetime of the present generation; otherwise its fluctuations in terms of labor and commodities can hardly be comparable to those that other metals have experienced during the past twenty years, when silver has registered a high of $1.35 per oz. and a low of 24c.; copper has varied from 37c. to 7½c. per pound; lead from 11c. to 4c.; and zinc from 20c. to very nearly 3c. And similar changes in the prices of these metals seem likely to recur in the future.

We have heard much of the diversification of crops and business. The farmer is told that he must not depend alone on cotton or corn or wheat; the retail merchant, following the lead of the department stores, seeks to broaden his lines of stocks; the manufacturer branches out into new fields whenever the opportunity presents itself; and the financial house classifies its investments. Why isn't a modification of this policy suitable for mining companies, and why should not all of them, in addition to their silver or copper or lead or zinc mines, make a determined effort to add to their holdings one or more gold mines, on whose profits they could always rely, especially when their major source of income was cut down by depression?

Diversification of mining, with gold as one of the products, is far safer than in the case of crops; for wheat, cotton, oats, and corn are all likely to be off in price at the same time, but when other metal prices are down, gold becomes relatively just that much more valuable.

I hold no brief for any particular gold mine or prospect. I am not trying to boost any particular district, but a considerable amount of travel and study has convinced me that opportunities do exist, that promising gold mines and prospects are lying idle at present, and that they merit careful investigation by companies which can command the technical skill and the capital necessary to develop them and put them on a producing basis.

The finding of any new bonanzas is unlikely, except possibly in some of the few unexplored districts; but many mines should be able to turn out a substantial quantity of gold at from $12 to $18 per ounce, and to repay the initial investment with a substantial rate of interest.

Many of these properties are offered at unreasonable terms, but in most cases, where reputable people really mean business, these terms can be modified so as to provide for purchase on a royalty basis, or for deferring substantial payment until development has advanced to a point where the value of the property is demonstrated.

We know that the possession of a large gold reserve is the greatest asset to a nation, whether in peace or war; and the possession of a good gold mine should be of similar value to a mining company. It would stabilize the price of its stock, enable it to maintain dividends through periods of depression, and to retain at profitable employment at least a substantial percentage of its staff and employees.

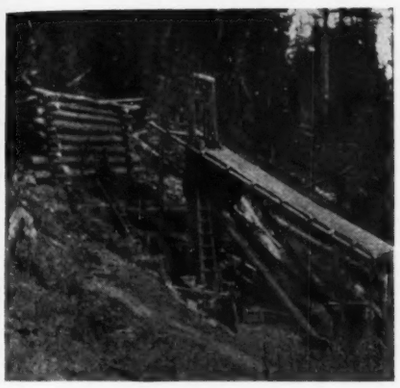
No one will seriously question the wisdom of such a plan, but how is it possible to justify the risk of money involved in departing from the conservative policy of refusing to explore these old mines or prospects unless they come up to certain well-defined and stiff standards? Well, mining at best is a risky business, and some risk must be taken if progress is to be made. Proved and developed gold mines can be acquired only by purchase, and their price is likely to be well inflated by the favorable positions that they have now come to occupy.

The point of my suggestion is that nearly every base-metal mining company that has not shut down entirely is now striving to meet obligations to its employees by keeping on salary and payroll a larger crew than it really needs or wants. Instead of employing these surplus men to develop or produce an excess of debased metals, would it not be better to use them to prospect, explore, or develop such likely gold properties as may come to the attention of the management? If these efforts were unsuccessful, the cash loss to the company would be little, if any. If successful, there would be a gain to the nation, the company, and its stockholders.

G. M. Colvocoresses.

Phoenix, Ariz.

Alexander Leggat, of Butte, Mont., sends an interesting photograph showing a miner's solution of the current unemployment problem. In explanation he writes: "This man, a good miner and experienced leaser, some years ago had a lease on a property high in the Tobacco Root range, in Madison County, Mont., the shipping ore occurring in pipes and pockets in limestone, and he stored the low-grade ore broken in development in old drifts for 'future reference.' Last fall he acquired a two-stamp battery, plates, crusher, some pipe, and a Pelton wheel, and built a little mill on a creek below the mine. He put in the winter, all alone, hoisting the stored ore out of a 30-ft. shaft; then, as soon as conditions permitted, this spring, he started milling.



"A rancher from the valley below hauls enough ore to fill the bin, between 40 and 50 tons, in a week; this runs the mill for ten or twelve days, when another supply is hauled, the miner running the mill every day. On account of water shortage he has recently added a 5-hp. gasoline engine to help out the water wheel and is now running on ore from the several old dumps in the vicinity, with satisfactory results.

"Several other little 'one-horse' outfits are working on a comparable scale in that region and apparently 'making the grade.' The range as a whole offers opportunities for competent men with a little capital or backing, and who are not afraid of hard work, to operate on a small scale with no overhead and a minimum of payroll expense, shipping their high-grade and milling the medium and low-grade ores. It has been leaser's country for years, and there is no shipping ore in sight, but its record indicates that many bonanza shoots are yet to be found by those with courage to take the miner's chance and do some digging."

Caving Methods

To the Editor of "E.&M.J.":

In the article by Morris J. Elsing in the July 13, 1931, issue of *Engineering and Mining Journal*, entitled "Caving Methods," there occurs the statement that the first practical application of caving methods of mining in Western mining districts was at the Ohio Copper Company's property in Bingham Canyon, Utah, in 1906, and that the next applications of the principle were at Ray Consolidated, in 1911, followed closely by Inspiration and Miami, with Phelps Dodge & Company at Morenci starting in 1911 about the same time as Ray. The article further states, "The first real caving methods were used at Cananea, Sonora, Mexico, in 1922."

In the interest of historical accuracy, may I be permitted to give the following account of the adoption of caving methods at Cananea, Mexico, early in 1906. Whether the methods there used would be classified by Mr. Elsing as "real caving methods" I cannot say, except to remark that the methods adopted were based on the best Lake Superior practice of that period.

In December, 1905, being then general manager of the Cananea Consolidated Copper Company, I determined to make a study of caving methods as used in the Lake Superior region, with the idea of replacing the expensive square-set timbering by which we had been trying vainly to hold up the mountain over the enormous stopes we were then working. Having obtained courteous permission from Mr. Thomas F. Cole, then president of the Oliver Iron Mining Company, at Duluth, to visit any of the United States Steel Corporation properties under his charge, I decided to go personally and study the problem myself.

I took with me Mr. Harry Kirk, assistant superintendent of mines under his brother James Kirk, who was in charge of our mining department. We were received at Duluth with unexpected hospitality, and a private car with special engine was put at my disposal to permit me to make my visits to the various mines in the most comfortable, convenient, and expeditious fashion. My friend, Mr. Dwight E. Woodbridge, volunteered to accompany us, and his thorough knowledge of the mines of the district, and the special peculiarities of local conditions and corresponding variations of mining method, made him a most valuable guide and greatly expedited our studies during the week of Dec. 17 to 23, 1905, which period was devoted to an intimate inspection of the more important mines where slicing and caving methods were being practiced.

Many of the observed conditions were so similar to those obtaining in our Cananea mines, and the advantages of caving compared to square-set mining were so evident, that I decided then and there to adopt a caving plan for the big stope in the Oversight mine, at Cananea, which we had found practically impossible to keep open by square-set timbering.

As the caving system was entirely unknown in the Southwest, a lack of confidence in its feasibility was sure to be encountered on the part of our foremen and miners. In fact, it seemed probable that the greatest obstacle would be psychological rather than practical. It was decided, therefore, to engage a competent man as consultant to come to Cananea and by his presence give confidence to our own men.

Through the kindness of Mr. Cole, I was put in touch with Capt. John Pengilly, a retired mine captain who was thoroughly familiar with Lake Superior practice in all its phases, and he was engaged to visit Cananea and give us the benefit of his experience and advice.

On my return to Cananea in January, 1906, the preliminary work was at once begun to install the system in the Massey orebody in the Oversight mine. Soon after, Captain Pengilly arrived and succeeded in arousing the interest and even the enthusiasm of our men in the plan. Unfortunately, the captain caught a severe cold, which developed into a fatal pneumonia, so we were soon deprived of his counsel. The plans, however, as approved by him went forward, and the Massey stope, including an enormous area of crushed ground, was successfully reclaimed, and the mining costs were greatly reduced.

My own connection with the Cananea company ended on July 1, 1906, so I cannot testify at first hand as to the mining operations after this time, but it has always been my understanding that slicing and caving methods continued to be used wherever the underground condition permitted.

In view of the above facts, therefore, I think the date of 1922 ascribed by Mr. Elsing as the date of the adoption of "real caving methods at Cananea" is an error, and that the real date should be early January, 1906. The only question that remains is what Mr. Elsing considers "real caving methods."

New York City. ARTHUR S. DWIGHT.

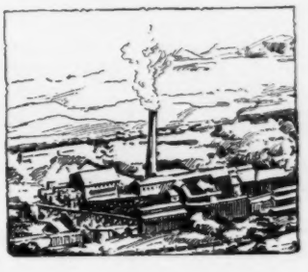
To the Editor of "E.&M.J.":

In reply to Colonel Dwight's query as to what I consider "real caving methods," I would say that ore has been won by caving in prehistoric times, but not in such a way as would class it as a modern mining method. I am aware that ore was recovered in Cananea by caving prior to 1922, but from the descriptions received from those immediately connected with these operations I did not feel justified in classing them as caving methods.

I was first employed at Cananea in 1910 as chief geologist and later as superintendent of mines, and was connected with the Cananea Consolidated Copper Company for many years. From the old stope records I made glass and celluloid models of every stope that was mined from the beginning of operations and was not only familiar with the shape and size of the deposits and the method of mining, but I knew, also, the year in which every stope was mined.

I have always been an enthusiastic supporter of the top-slicing method as used at Cananea. I regret that in my article on "Top-Slicing in the Southwest" I did not give Colonel Dwight credit for having introduced the method at Cananea in 1906. I did not know this. I was not aware that a caving method was then introduced, and I have not the slightest idea as to the type employed. I can say that the old stope records do not show any details of development, chute arrangement, level spacing, boundary blocks, or anything else by which the early caving at Cananea could be classed other than a "draw-and-run" proposition for recovering small amounts of ore. It was for this reason that I did not consider the early Cananea caving operations as "real caving methods" as today understood. MORRIS J. ELSING.

Tucson, Ariz.



Among contributors to this issue:

Director Emil Schrödter, general manager of mines of Mansfeld A.G. für Bergbau u. Hüttenbetrieb (Mansfeld Copper Company), has been connected with that organization since 1920. Mr. Schrödter is a graduate of the Munich Institute of Technology. He has also studied at Munich University and the Berlin Mining Academy.

Dr. Ing. E. van Erckelens, general manager of Norddeutsche Affinerie, has been connected with that plant since 1923, previous to when he was employed at the Braubach lead-silver smelter. He is a graduate from the Aachen Institute of Technology.

Dr. Richard Glatzel, general manager of mines at Meggen, is a Freiberg graduate. Prior to his connection with Sachtleben, in 1925, he directed the operation of German coal, lead, and iron mines. He has also acted as consultant for mining companies on the Continent, in Asia, and in Canada. Since 1920 he has served as a member of the committee on ore dressing, Gesellschaft deutscher Metallhütten- u. Bergleute (German Institute of Mining and Metallurgy).

Dipl. Ing. Richard Seiffert, Dipl. Ing. Erich Koch, and **Dipl. Ing. Hermann Matthies,** the co-authors of the article on zinc smelting, are graduates of Bergakademie Clausthal. Mr. Seiffert, who has been with Metallgesellschaft since 1901, is general manager of Berzelius Smelters. He is also alternate member of the board of directors of Metallgesellschaft. Mr. Koch, manager of the Duisburg plant, has been with the company since 1918, and Mr. Matthies, manager of the Bensberg plant, has served since 1919.

Dipl. Ing. Fritz Lakwey, a graduate mining engineer, is at present economic director at the mines of Georg von Giesche's Erben, in Breslau.

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Bernard Beringer has resigned as a mining engineer on the staff of Cerro de Pasco, at Morococha, Peru, and expects to leave there for England about the middle of October.

S. Power Warren has returned to Golden, Colo., where he will resume his duties as associate professor of metallurgy for the coming year, after a year's leave of absence.

Hugh M. Wolflin has been appointed supervising engineer at the Intermountain Experiment Station of the United States Bureau of Mines, Salt Lake City. He succeeds **Dr. Dorsey A. Lyon,** who resigned recently.

Dr. A. W. Gauger, formerly director of the division of mines and mining experiment at the University of North Dakota, has been appointed director of the mineral industries experiment station and professor of fuel technology at Pennsylvania State College.

Prof. W. R. Hobbs, of the geology department at the University of Michigan, will said for Europe on Aug. 22. He will attend the International Geographical Congress in Paris in September and will participate in an excursion to the Sahara.

J. C. Hutchinson has been appointed general manager and **R. G. Cole** has been appointed superintendent of Northwest Magnesite, at Chewelah, Wash. The new appointments follow the death, several weeks ago, of B. B. Rogers, former manager of the plant.

Claude Ferguson, of Grass Valley, Calif., has been appointed general manager of Granada-Rouyn Mining, in the Rouyn district of Quebec. He succeeds **W. J. Hosking,** who will operate some properties he has acquired for himself in the district east of Granada.

Paul A. Schafer will become assistant professor of geology at the Montana State School of Mines, to release **Dr. E. S. Perry** for some studies he is making. Other personnel changes at the same institution follow: **Prof. F. C. Gilbert** has resigned and will be succeeded by **J. U. MacEwan** as instructor in metallurgy; **Melville Sayre** has been appointed assistant professor of English to succeed **Henry C. Johnson,** who resigned in 1930.

Dr. Edwin Fitch Northrup has been awarded the Edward Goodrich Acheson medal for 1931 of the American Electrochemical Society. It will be presented at the meeting in Salt Lake City on Sept. 3. From 1903 to 1910, Dr. Northrup was secretary of the Leeds & Northrup Company, and from 1910 to 1920, assistant professor of physics at Princeton University. Since 1916 he has devoted himself chiefly to the development of high-frequency furnaces, used for the melting of metals and alloys.

Dr. F. N. Guild, who recently retired from the professorship of optical mineralogy at the University of Arizona after 34 years of service with that institution, is succeeded by **Dr. Max N. Short** of the Geological Survey at Washington, D. C. Dr. Short was born at Pembina, North Dakota, 41 years ago. He was graduated from the University of California in 1911 with the degree of bachelor of science in mining engineering. He practiced his profession for the following seven years in the Southwest, and served with the 319th engineers in the World War. After the war the federal board of vocational training sent him to Harvard, where he studied geology and from which he received his doctor's degree in 1923. During the next year he worked as assistant to Dr. L. C. Graton at Harvard. In March, 1924, he took the United States Geological Survey examinations and received the highest grade out of 85 men examined. Since that time he has been with the Survey except during 1927-28, when he taught Dr. Graton's courses while the latter was on sabbatical leave. Dr. Short has a long series of publication to his credit, the most pretentious being U.S.G.S. Bulletin 825, entitled "Microscopic Determination of the Ore Minerals." His mimeographed manuscript of this bulletin has been used as a text at Harvard and elsewhere and is generally believed to be the best exposition on the subject in print. He is a member of the Society of Economic Geologists, a fellow of the American Mineralogical Society, a member of the committee on paragenesis of ore minerals of the National Research Council, and of other organizations.

PERSONALS constitute an attractive feature of a magazine of this type. Probably the most interesting ones record changes in employment. If a reader is promoted in his organization, or leaves one company to join another, he should keep his scattered friends informed of his movements. Of only negligible interest to the mining fraternity are notifications that short inspection trips and vacations have been taken. Engineers, particularly mining engineers, are normally peregrinating creatures. News items of journeys to little-known districts, or in connection with important missions, are most welcome, especially when accompanied by short personal comment of an informative or critical nature. When notifying us of change of address, the subscriber is urged to say a word or two about himself or one of his friends. At other times, send a note direct to the Editor, remembering that personal or pictorial photographs are occasionally used to lighten the text.

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Obituary

Rush M. Hess, mining engineer, of New York, died suddenly on Aug. 14, at Cokercreek, Tenn., where he was making an examination for the Annette Mining Company.

E. A. Kilinski, geologist, died recently in Caracas, Venezuela. He graduated from Columbia University in 1921 and received his Master of Arts degree in 1923. He was thirty-two years old.

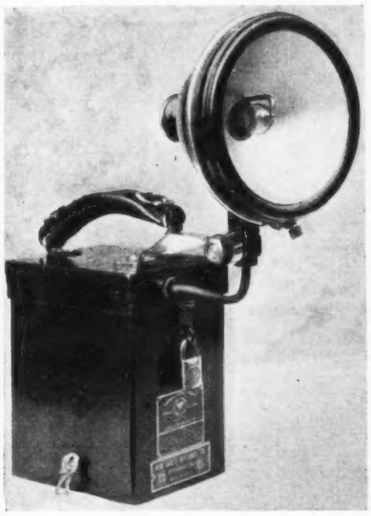
W. D. Blackmer, mining engineer, of southern Arizona and the west coast of Mexico, died at his home in Nogales, Ariz., on Aug. 4. He was formerly manager of the Palmerto mine in Sinaloa, Mexico. Mr. Blackmer was 55 years old.

George E. Cooley, inventor of several devices used extensively in the Tri-State district, died at Miami, Fla., on Aug. 6. He had resided in Joplin, Mo., for about 50 years. Mr. Cooley had been given credit for being the first to operate a mining jig by other than hand power, and he also invented the Cooley sludge table, still widely used. He was 83 years old.

INDUSTRIAL PROGRESS

Portable Floodlight Approved by Bureau

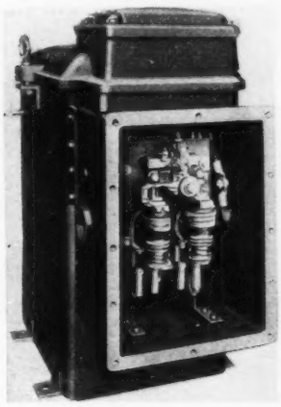
Other New Equipment



A safe light for gaseous atmospheres

APPROVAL of the U. S. Bureau of Mines has just been received for a portable floodlight developed in the last twelve months by Mine Safety Appliances Company, Pittsburgh, Pa. Considerable time and effort has been expended to this end because of the difficult problem of designing an approved bulb mounting that would insure safety and prevent an explosion even though a bulb should break when the light was burning in an explosive atmosphere. This difficulty is due to the fact that the bulb takes four times as much power as the ordinary electric cap lamp bulb. It requires considerably more energy to keep the filament drawing for some time after the circuit has been broken.

The accompanying photographic reproduction shows the batteries of this lamp mounted in a neat metal case, the cover locked with a padlock and a Yale-type key; also the reflector assembly arranged so that it can be turned in any direction desired. In this light, the reflector is of the mat surface type and gives a maximum beam candlepower of about 400. The battery consists of either six Model E Edison cells or four Model G Edison cells, each combination giving the same capacity. These cells are series-connected, and because of the higher voltage, the inherent efficiency of the bulb is almost double that of the electric cap lamp bulb. The design of the bulb as selected gives a burning time of 8 to 8½ hours, the total amount of light given by the bulb being about eight times that of an electric cap lamp. The lamp weighs about 16 lb. and is equipped with a convenient leather handle for carrying. It is particularly applicable for use in gaseous workings and in powder magazines. If necessary, it can be had with a polished reflector which would give a beam light of several hundred candlepower. Another application of the lamp would be in open ditch work at night where gas lines are involved, as around metallurgical plants, and wherever gas may be leaking to such an extent as to cause a dangerous mixture. Graham Bright, chief electrical engineer for the Mine Safety company, says that he believes the lamp will fill a long-felt want where a large amount of light is required in localities and atmospheres which will not permit any but an approved light to be used.



An across-the-line motor starter for hazardous locations

Motor Starters for Hazardous Places

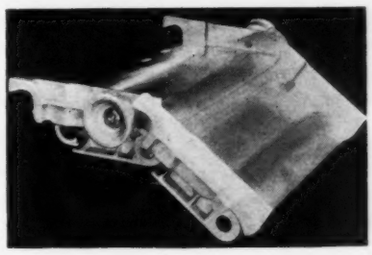
A new line of explosion-proof motor starters has been built by the Electric Controller & Manufacturing Company, Cleveland, Ohio, to meet requirements of certain hazardous locations. One is shown in an adjoining cut. It is the EC&M Type ZS across-the-line, explosion-proof, motor starter, which provides for full-voltage starting of squirrel-cage motors. It may also be used with an automatic field switching panel for synchronous motors and for controlling the primary of slip-ring motors. The operating mechanism is well lubricated and is protected against moisture and corrosion.

Another Steel-Mill Type Motor

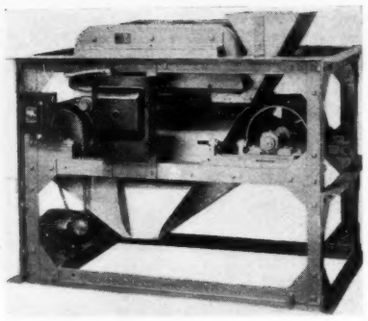
A new steel-mill type motor designed for heavy-duty work, such as auxiliary drives, cranes, hoists, shovels, coal and ore bridges, mine hoists, conveyors, and similar applications, has been developed by the cooperative efforts of steel mill engineers and those of the Westinghouse company. It is said to have many new features. Field coils and poles are positively secured to the frame, without washers, springs, or other parts that may become loose. The improved bearing housings are securely held from turning and accommodate ball or roller bearings of any standard make. Deep commutator bars and wide risers permit many replacings, giving added years of commutator life. Injurious sparking is prevented. The construction permits high overload capacity without injury to commutator or brushes. The frame is of massive cast steel and is split horizontally so that the top half can be swung back without disconnecting any leads.

A Heavy-Duty Apron Feeder

Exclusive sales rights to a heavy manganese-steel apron feeder patented by the Kensington Company, of Chicago, have been secured by the Robins Conveying Belt Company, 15 Park Row, New York, through an affiliation with the former company. The feeder, which is to be manufactured jointly by the two companies, is known as the Robins-Oro feeder and is intended to handle abrasive materials or heavy tonnages of ore and rock in large pieces. An accompanying illustration shows two pans of the carrying surface. The design is said to afford greater dependability and lower maintenance cost. The pans or flights forming the carrying



Two pans of new heavy-duty apron feeder



Magnetic separator designed especially for fine material

surface are not bolted to a pair of chains, as is the usual feeder of this type, but have chain links cast integral with them. These flights, moreover, are double-beaded, which prevents material from sifting through and permits operation at a substantial slope. Alignment of the pan is maintained by providing, on the under side of each, several flat surfaces which come in contact with corresponding surfaces on the adjacent pans. Positive connection between pans, furthermore, is insured by double-interlocking lugs on each pan, which keep the feeder as a whole moving along in a rigid surface without deflection and permit loading without damage. The carrying surface is continuous and smooth, and rides on manganese-steel rollers mounted on the feeder supports. Thus the weight of pans and the material carried is not supported on chains. Each driving sprocket has reversible, removable manganese-steel teeth bolted to a cast-steel center. The feeder has a capacity up to 2,000 tons per hour and can handle fragments of ore or rock 3 or 4 ft. in size and weighing a ton or more apiece.

Separates Fine Material Magnetically

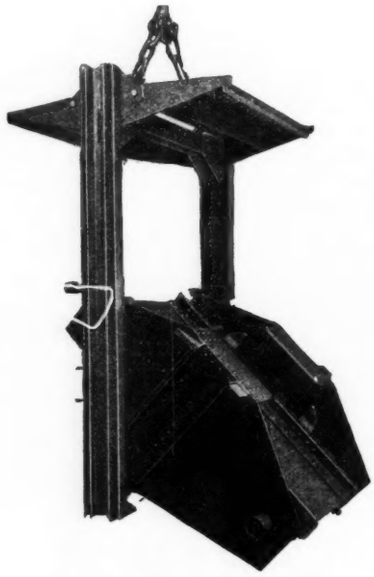
What is said to be a new principle is embodied in the design of a new magnetic separator developed by the Magnetic Manufacturing Company, Milwaukee, Wis. This machine, it is said, will separate free iron efficiently from material that has been ground to 20 mesh and finer. The manufacturers claim that hitherto no magnetic separator could be applied successfully for treating such extremely fine material and that it is only by a unique and ingenious design that the unit can function. The new separator is shown above.

Steel Woven Wire Screens in Coarse Meshes

After five years of experimentation the Ludlow-Saylor Wire Company, of St. Louis, claims to have produced in the coarse meshes a full line of alloy-steel woven-wire screens, which are suitable for service either in revolving-screen jackets or in vibrating-screen sections, as well as for various other applications where the work is rough and abrasive. These screens are being introduced under the name of "Spring-Steel." They may be had in approximately 250 widely used grades and meshes, ranging from 4-in openings made of heavy bars down to $\frac{1}{16}$-in. openings of No. 20 wire.

Metal Hose Flexible

A flexible metal hose, known as "Seamlex," and made in a number of different styles to suit a wide variety of applications, has been introduced by the Seamlex Corporation, 1028 47th Ave., Long Island City, N. Y. The helical corrugation in the side of the hose, which makes it flexible, may be either open pitch or close pitch, as desired, and the protective covering, consisting of metal braid or armor, may also be varied; likewise the fittings.



Self-dumping cage gives speed in hoisting

In mines where cars are hoisted on cages, fast work is possible with the Olson self-dumping cage, shown in the above illustration, according to the Eagle Iron Works, Des Moines, Iowa, the manufacturers. This cage was developed primarily for shaft coal mines, but is thought worthy of the consideration of metal-mine operators because of the speed which its automatic features make possible. The cage shown is the Type OC-7 and is built to meet the fastest hoisting requirements. The loaded car, on entering it, bumps off the empty and operates the car-stop and locking mechanism so that the signal to hoist may be given as soon as all wheels of the loaded car are on the cage. Once on the cage, the car automatically locks itself. The cage is strongly built, having a rigid head truss and strong lifting members. The deck rests and turns on heavily reinforced-steel trunnions and has a clear floor space free from operating mechanisms. Guide angles are lined with renewable wear plates.

Aluminum for Fencing

A recent development in the fence industry has been the adoption of aluminum for making woven-wire fences. It is said to be meeting with widespread approval because it is non-corrodible and does not require painting. All factors considered, it is said to be cheaper over a period of years than fences made of other metals. A booklet discussing it has been issued by Page Steel & Wire Company, Bridgeport, Conn.

New Welding Set

A new line of single-operator welding sets in which are incorporated many improvements over past designs has been announced by General Electric. This is designated as the WD-20 line, the types included covering the 100-, 200-, 300-, 400-, and 600-ampere ratings. The line includes portable and stationary sets.

Blowers Duplicated for South Africa

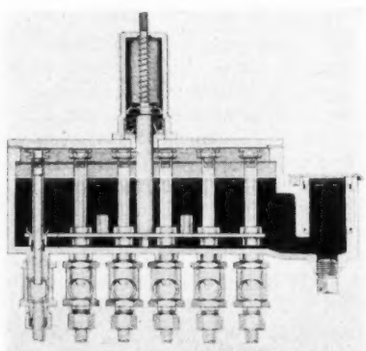
Another shipment of R-C-W heavy-duty rotary positive blowers was made to South Africa recently from the Connersville plant of the International-Stacey Corporation. These blowers are rated at 12,500 cu.ft. of air per minute at 2-lb. pressure. They are duplicates of eight similar machines previously installed by the Mufulira Copper Mines, Ltd., for flotation work.

Multiple Oiler Automatic

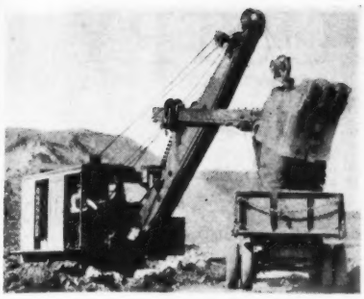
A simply built and non-clogging automatic multiple oiler, which is illustrated below, has been announced by Gits Bros. Manufacturing Company, 1848 South Kilbourn Ave., Chicago. With it controlled amounts of oil, varying from $\frac{1}{4}$ to 10 drops, can be delivered by gravity to each bearing, regardless of the viscosity of the oil, as long as the oil will flow through passages never less than $\frac{1}{16}$ in. wide. Each oiler is made in eleven sizes having two to twelve leads, and is intended to be located within 3 ft. of the bearings lubricated.

Colored Enamel Insulation Serves Dual Purpose

Direct-current motor windings, coated with a bright orange-colored enamel instead of the usual black finishing



Non-clogging multiple oiler for automatic controlled lubrication



New one-yard convertible excavator

coat, are now being produced by the Reliance Electric & Engineering Company, Cleveland, Ohio, to obtain steadier operation and longer life. The colored enamel serves to aid in detecting dirt and affords, in addition, an excellent insulation.

Locomotive Has Greater Hauling Capacity

One of the illustrations shows a so-called "Duplex" locomotive developed by Vulcan Iron Works, of Wilkes-Barre, Pa., for coal-stripping service. In this new design, the manufacturer has produced a comparatively heavy steam locomotive, the weight of which is distributed over a greater length of rail, thus making track upkeep easier and adaptable to all conditions involving handling of heavy loads on steep grades with sharp curves on poorly laid track. Two swiveling trucks enable it to negotiate sharper curves and provide greater traction on poor roadbeds. The locomotive illustrated weighs 55 tons complete, the weight being distributed over eight driving wheels in two four-wheel swiveling trucks, each having a pair of 13x16-in. piston-valve type cylinders with valves controlled by Walschaert gear. Thus, each truck is a complete unit and takes its steam through flexible connections from the boiler. Driving wheels are 33 in. in diameter, truck wheel base is 5 ft., and total wheel base, 26 ft. 5 in. The over-all length of the locomotive is 32 ft. 6 in. The locomotive is equipped with Westinghouse modified No. 6 ET air-brake apparatus. Under preliminary tests this locomotive developed a tractive effort upwards of 30,000 lb. Steam is controlled by a special arrangement, so that both trucks may be operated simultaneously or the steam to either one may be partly or completely shut off, thus preventing slipping of the wheels. This operates independently of the main throttle.

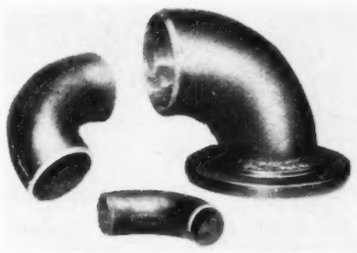
Power is applied to wheels under tender also in this engine

Sturdy 1-Yd. Shovel Is Convertible

An illustration shows a Model 32-B, 1-yd. Bucyrus-Erie excavator, convertible to shovel, dragline, crane, or clamshell. In its design special attention has been given to balancing the hoisting, crowding, swinging, and dumping motions so as to produce the shortest possible cycle. It is provided with either gasoline, diesel, or electric power, rope or chain crowd on the shovel, and special extra long and wide mountings for dragline work on soft ground.

Elbows for Welding

A wrought-iron elbow, known as the Weldell, is now being made by the Locomotive Terminal Improvement Company, Railway Exchange, Chicago. It may be had either in standard or light-weight sections in Byers wrought iron, Toncan iron, Armco iron, copper-bearing steel, and wrought steel. The elbows are made by cutting two pieces of homogeneous metal plate to proper size, and forging them to exact radius and dimensions. They are then fused together with a reinforcing rib along both the outer and inner radius curvature. They have the same radius and center to face measurements as standard



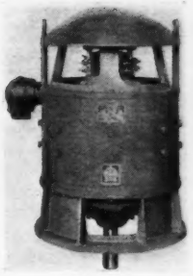
A wrought-iron elbow for welded lines

radius fittings, and are interchangeable with standard fittings in revising existing piping. They may be welded directly into a pipe line, eliminating all fittings and threads.

Some New Portable Compressors

To its line of portable compressors the Chicago Pneumatic Tool Company, New York, has added a machine of 360 cu.ft. capacity, which permits the use of an additional number of rock drills, clay diggers, pavement breakers, and similar compressed-air tools. Aside from this compressor, the line has hitherto ranged from 72 to 280 cu.ft. capacity.

Another line of compressors to which attention has recently been called is that of the Davey Compressor Company, Kent, Ohio. These compressors are gasoline driven and are air cooled. The heads and other parts exposed to high heat are made of a special aluminum alloy which permits rapid removal of the heat. These surfaces, moreover, are deeply finned, which multiplies the radiating area of the outer surface. Thus the air goes to the receiver with much of the original heat withdrawn



One of a line of vertical d.c. motors ranging up to 50 hp.

and at a perfectly safe temperature. Air cooling makes for a lighter machine, first because aluminum castings are lighter, and, second, because piping is reduced to a minimum, water jacket and radiator being eliminated. Advantages of this design have been exemplified in comparative tests made with a Davey compressor of 142 cu.ft. capacity. The company is now designing two units of larger size, one with 240 cu.ft. capacity, and the other with 320 cu.ft. capacity.

Direct-Current Vertical Motors

A line of direct-current motors for vertical operation has been developed in sizes up to 50 hp., 1,150 r.p.m., by Reliance Electric & Engineering Company, Cleveland. This is the Type T line. The motors are provided with a ring base for mounting and a drip cover. If desired, they can be mounted direct to the machine driven as an integral part of it. Bearings are of ample size. Handling is facilitated by two heavy eyebolts.

■

Industrial Notes

Allis-Chalmers Manufacturing Company, Milwaukee, has acquired the principal assets of the American Brown-Boveri Company, Inc., and the capital stock of the Condit Electrical Manufacturing Company, of Boston. It has thus secured several new lines of equipment such as electric railway apparatus, mercury arc rectifiers, electrical furnaces, and oil circuit breakers.

■

Bulletins

Mine Locomotives. General Electric Company, Schenectady, N. Y. Bulletin GEA-707 C, entitled "The Modernization of Mine Locomotives."

Industrial Control. General Electric Company, Schenectady, N. Y. Catalog GEA-606C 1931.

Gears. D. O. James Manufacturing Company, 1120 W. Monroe St., Chicago, Ill. Catalog No. 136. Continuous-tooth herringbone speed reducers and gears.

Deep Well Pumps. Pomona Pump Company, Pomona, Calif. Bulletin No. 1A on water-lubricated turbine pumps.

Welding. Joseph T. Ryerson & Son, Inc., Chicago, Ill. Pamphlet on welding rod and equipment for gas and electric welding.

NEWS OF THE INDUSTRY

Alaska Juneau Continues Deep Development Program

Deeper development of the Alaska Juneau mine is being continued. The winze has reached a depth of 600 ft. Both crosscutting and drifting indicate a block of ore 1,200 ft. long by 40 ft. wide. Development is to be continued to greater depth, and it is expected that a large additional tonnage will be proved. Surface trenching on the newly acquired claims to the north of the Ebner has given encouraging sample results and is an incentive to further exploration.

During July, 1931, Alaska Juneau mined and trammed to mill 337,730 tons, from which the estimated receipts were $304,000 or 90.01c. per ton. Operating expenditures were $174,000, or 51.52c. per ton, and operating profit was $130,000, or 38.49c. per ton. Interest received less other expenditures totaled $1,600, adding $131,600 to surplus for the month.

■

Australian Bounty Scale Fixed

The Australian federal government has amended its recent Financial Emergency Bill, which provides for a reduction in the bounty on excess gold production from £1 to 10s. The new arrangement establishes a fixed sliding scale which will increase the bonus 1s. per ounce for every 3 per cent decline of the exchange premium. Thus when the exchange reaches par, the full bonus of £1 per ounce of gold produced in excess over the average production for the three years 1928-1930 inclusive will be payable.

■

Abana Passes to Mining Corp.

On Aug. 15, 1930, Mining Corporation of Canada, Ltd., accepted the title of Abana Mines, Ltd., as security for loans approximating $50,000, which were advanced for the purpose of further developing the latter company's copper-zinc deposit, near Dupuy, Quebec. These funds not having been repaid, Mining Corporation will complete the development program and operate the property whenever the metal-price situation justifies such a course. Mining Corporation will issue shares to all creditors, thus terminating a five-year career of difficulties and disagreements for the Abana company. The company was formed in 1925, and has been the subject of continual litigations and elections of officers.

■

Discover Cerite in Colorado

A vein of cerite in a pegmatite dike has been discovered near Jamestown, in Boulder County, north central Colorado. The pegmatite cuts the Pre-Cambrian schist-gneiss complex, and the cerite vein follows it for several hundred feet. At some points it pinches to a few inches; at others it widens out to about 2 ft.

■

Kennedy Mining & Milling to Install Flotation

Final metallurgical studies have been completed by Kennedy Mining & Milling, at Jackson, Calif., and contracts have been made for the machinery necessary to convert the present mill into a flotation unit. It is planned to operate 60 stamps, and to send the product from the stamp batteries to a 35x8-ft. Dorr thickener, the underflow being sent to an 8x21-ft. Dorr classifier, from which the rake product will be delivered to a 5x5-ft. Allis-Chalmers ball mill in closed circuit with the classifier. The classifier overflow will be handled by ten Kraut flotation machines and the flotation product will be sent to two Kraut cells for recleaning. The final flotation product will be received in a 12x6-ft. thickener and dewatered upon a 6x2-ft. Dorr filter. It is expected that the new equipment will be received within six weeks.

■

New American Development Mill

The American Development Company, of San Francisco, non-metallic mineral producer, is rapidly completing its plant installation at West Berkeley, Calif. Raymond mill, Hardinge mill, screening and jigging units are completed and in operation. A 5x20-ft. tube mill, silex lined; and air separator, bucket elevators, a crusher, and storage bins are in place, and a drying furnace is being completed. Another tube mill and accessories for the preparation of barium-sulphate pigment material are being erected. Preparations are also being made for the handling of scheelite ores. The company produces a variety of industrial minerals as well as undertaking commercial grinding. Five deposits supply raw material from Nevada.

■

El Tambor Gold Rush Declines

The rush to the recently reported gold find at El Tambor, Sinaloa, Mexico, has been checked by several factors, according to press dispatches from Mazatlan. A rapidly growing typhoid fever epidemic has caused many to leave. Eleven deaths from the fever were reported in one day, and the weekly totals are reported increasing alarmingly. Gold miners are said to have stated that original reports of the importance of the find were greatly exaggerated, that the principal claim is making only a fair showing, and that individuals are obtaining small amounts of the metal. The population in the district has declined to 1,000 from a total of 3,000 a month ago.

Wright-Hargreaves Starts Sinking New Shaft

Wright-Hargreaves Mines, Ltd., operating the third largest gold producer in the Kirkland Lake district of Ontario, has broken ground for a new central ore hoisting shaft. It will be known as No. 4, will be sunk to a depth of 3,000 ft., and ultimately will be extended to 4,000 ft. The shaft, measuring 14 ft. square inside of timbers, will have four compartments, and is scheduled to be completed early in 1933. A new Fullerton hoist capable of serving the mine to a depth of 4,000 ft. has been ordered for No. 3 shaft, which has just been completed to a depth of 3,126 ft., to allow lateral development work to be carried out on five new levels. An Ingersoll-Rand sinking hoist has been ordered for No. 4 shaft, which will have its first station at the 1,200 level. To supply air for the additional development entailed in the enlarged program, a 2,500-cu.ft. compressor is also on order, to be delivered Oct. 1. Steel is being erected for a new crusher station to be completed Oct. 1. A new change house and staff quarters, the former to accommodate 850 men, are also being erected. Plans are being considered for the installation of a pilot flotation mill for re-treatment of tailing.

■

Driving New Sunnyside Tunnel

United States Smelting, Refining & Mining has started the driving of a new transportation and drain tunnel to its Sunnyside mine near Eureka, Colo. The tunnel, started at an altitude of 11,000 ft., will be 10,000 ft. long, and 8x9 ft. in the clear, giving a vertical depth of 1,600 ft. below the mine at 12,600 ft. A Conway electrical shovel is being used for loading cars with waste. Four Gardner-Denver rock drills, mounted on a carriage, are used for drilling. A trolley-type electric locomotive is being used to haul cars having a capacity of 35 cu.ft. When completed, ore cars carrying 10 to 15 tons will be used in the tunnel. When the tunnel is completed, wire-rope tramway connecting the present main Sunnyside working tunnel and the mill at Eureka will be built to the portal of the new adit. Three shifts are working.

■

Silver King Opens New Ore

A showing of high-grade silver-lead ore was struck recently by Silver King Coalition Mines, operating in the Park City district of Utah, according to M. J. Dailey, manager of the property. The find was made while cutting through the quartzite on the 1,100 level, 600 ft. below the Silver Hill shaft station, and, according to Mr. Dailey, the ore seems to be in a new channel, not connected with any of those producing in this section of the mine. No further details are available as yet.

C.&H. Centennial No. 2 Shaft Shut Down for Repairs

Calumet & Hecla Consolidated, Michigan copper producer, has shut down productive operations from its Centennial No. 2 shaft, pending repairs to the rockhouse. The structure will be placed in good condition, as this shaft promises considerable production. The shaft is being completed from the 43 level, where good ground was opened by a drift from No. 1 North Kearsarge, and from which depth the shaft was holed through 1,200 ft. to the old bottom. Drifts have been proceeding on two of the bottom levels, and three more have been prepared for opening.

Drifting is proceeding at depth on the Kearsarge lode in C.&H. lands, from the 78 level crosscut from No. 12 Conglomerate shaft; and from the 81 level crosscut from the Red Jacket shaft. In the south end of the property, the 78 level crosscut cut the Kearsarge lode with a very good showing of ore, which continued north and south for a considerable distance. A long stretch remains to be opened. At the north end, drifting is proceeding south from the 81 level.

The company's No. 4 Calumet Conglomerate shaft, which is being mined from the bottom up, recovering high-grade ore from the backs of old stopes and heavy shaft pillars, is now bottomed at the 49th level. Backs are being removed from the 47, 48 and 49 levels. Shaft pillars, which are 90 to 120 ft. thick, are the last to be removed, the level then being allowed to cave. A large tonnage remains to be mined before the shaft is abandoned, and at the present rate of extractlon, about 250 tons of ore daily, the shaft has a life of probably fifteen years. No. 2 shaft, in which mining of backs and pillars has been proceeding for many years, still has much good ground to be removed.

■

Bahia Increases Production

An official statement from the New York office of the Bahia Corporation, which, as related in this publication last September, is recovering carbonados and white diamonds by mechanical mining operations along the Paraguassu River in the State of Bahia, Brazil, gives the production from June 16 to July 31, 1931, as 452 carats of black diamonds and 326 carats of white stones. This production has been from a single pit on a part of the Piruca bend of the Paraguassu River. The properties of the company extend for 12 miles above the present operations. A force of 1,200 laborers is employed in preliminary stripping of overburden, after which the diamond-bearing strata are attacked with hydraulic elevators. Though at present scarcely outside the category of a speculative enterprise, those responsible for the operations of Bahia Corporation in Brazil expect that with the development of assured and increased production, the price of carbon will be materially reduced and black diamonds be thus made available for many industrial applications not now within the scope of practical utility. The success of the enterprise is said to rest on the ability of the company to accumulate and finance increasing stocks of carbon pending the passing of the existing industrial depression, and in its further success in refinancing to assure uninterrupted recoveries of stones from a sufficient number of pits and deposits to warrant the assumption that permanency of profitable operation is assured.

The company has just sold a large block of treasury stock, which gives it ample funds to develop and operate several additional pits.

■

Arizona Copper Mines Cut Wages About 10 Per Cent

Several of the leading copper producers in Arizona have announced wage cuts, including United Verde Copper, Inspiration Consolidated, and Miami Copper. The prolonged depression in the copper market is of course responsible for this drastic move, which brings the wage scale down to the 1921-22 level. The cut at Miami and Inspiration was 9 per cent. United Verde reduced its scale from 10 to 25 per cent, the cut increasing with higher-salaried workers. In addition, United Verde—which suspended production in May—will reduce its working force from 1,000 men to 600 men by Aug. 1. No further reduction in the number employed is contemplated. The company has been employing these men in repair and development work.

The reduction at Miami and Inspiration, both operating in the Miami district, went into effect on July 16. F. W. Maclennan, general manager of Miami, stated that by reducing the present wage scale to that of 1921-22 the company was attempting to continue to provide employment for as many men as possible.

Dome Mines Now Expanding Its Witwatersrand Operations

Exploration work having failed to develop any Canadian gold prospect that has seemed worthy of acquisition, Dome Mines, Ltd., is extending its activities into Africa. This does not mean that the company's property at South Porcupine is exhausted, for the ore reserves there have recently been increasing according to the annual reports, being 1,250,000 tons at the end of 1928; 1,300,000 tons at the end of 1929; and 1,900,000 tons at the end of last year. The grade of the ore is not given, but in the past has averaged between $7 and $8. Recent development has been in the greenstones.

Some time ago, Dome acquired 100,000 of the 1,500,000 issued shares of East Geduld Mines, Ltd., a new property under development, on the East Rand, in Transvaal. At the end of last year, 3,900,000 tons of 7-dwt. ore over a stoping width of 58 in. had been developed. A vertical shaft has been sunk, and a mill constructed, with a capacity of 60,000 tons a month. H. P. De Pencier, manager of Dome, is now in Africa superintending the opening of this mill.

Dome is also reported to have a large interest, along with Union Corporation, Ltd., in over 7,000 acres of land on the strike and adjacent to East Geduld, known as Grootvlei Proprietary Mines, Ltd., where the reef is expected to be cut at 3,000 ft. The Daggafontein property lies to the south, and present plans proved that development will be carried on by both the East Geduld and Daggafontein companies. In this work, Mr. De Pencier will also have an interest.

■

Activity at Gold Hill, Utah

Operations have been started at several properties near Gold Hill, Utah. Shipments of gold ore are being made from the old Alvarado mine. Recently the Garrison-Monster property shipped two carloads of high-grade lead carbonate ore. South Tintic Mines, of which R. O. Dobbs is manager, is starting work on the Dalmonego group. In the Cane Springs mine, Salt Lake interests are sinking on a fissure parallel to that which produced a substantial amount of gold ore several years ago. The arsenic mines of American Smelting & Refining and U. S. Smelting, Refining & Mining, which are in this district, are still shut down.

Photographs taken in July of this year, showing hydraulicking operations of the Bahia Corporation for the recovery of carbonados and white diamonds, on the Paraguassu River in Bahia, Brazil.

Increasing Gold Prospecting Embraces Entire World; Many Strikes Are Reported

THAT the world-wide economic conditions now prevailing are favorable to gold exploration becomes increasingly evident. Prospectors are active in virtually every known gold district. Their number is greatly augmented by many men who have found themselves otherwise unemployed, have managed to acquire a stake, and have gone out into the hills. Many are operating placer deposits on a small scale; others are setting about reviving old properties abandoned in days of high commodity prices, when gold mining was not as profitable as it can be in times like the present. Some dishonest advantage is apparently being taken of this otherwise healthy movement, as is evidenced by fantastic statements in certain press reports.

Stewart Campbell, Idaho State Mine Inspector, in a recent statement to the press, said that "Not in 30 years, or possible even a longer period, have there been so many placer gold diggers in Idaho as at present. Every river, every little creek in the placer districts is occupied," Mr. Campbell went on. "Along the upper and the lower reaches of the Salmon River, pumps can be seen on banks and on barges. Search for gold is proceeding in the Stanley basin, Riggins, Whitebird, the south fork of the Clearwater halfway to Elk City, and in the Boise basin, to name them at random.

"There are probably hundreds of men occupied. . . . Every digger becomes one less candidate for a job on the outside. Most of them are scratching for ground that the old-timers overlooked. Few of them are on ground that has been worked. Some of them are finding corners. Many of them are beginners, but are learning. A larger number of scouts are out for investing companies. More engineers are about than at any time since I have been in office. All are after gold properties. But when a man has a good gold prospect and knows it, he is not eager to sell."

Arizona furnishes news of activity in the quest for gold in several districts. The Payson district is said to be the scene of considerable prospecting, some of it being done on quite a large scale, the groups or companies concerned having employed crews of prospectors to go out for them. William Crawford, of Superior, Ariz.. is said to have completed financial arrangements in the East, and to be about to start operations on a large low-grade placer deposit near Superior on the Colorado River. George Newby, mining engineer, of Phoenix, examined this property several months ago. Engineers have been visitors in Oatman, Ariz., recently, and examined several claims in the immediate vicinity. A rich vein of gold ore was found by John Belcher, in the Pinal Mountains, according to reports from Globe.

Joseph Jackson, a young prospector of Loring, Alaska, financed by residents of Juneau, has filed eleven full mining claims for his backers on Chicagoff Island, southeast of Alaska. This property adjoins the famous old Chicagoff Mine. Samples of the ore have been sent to Alaska Juneau for assay. Jackson claims that this is an extension of the old Chicagoff lode; that the mineralized zone varies from 2 ft. to 24 ft. in width, with a general average of about 7 ft.; and that the quartz gangue shows free gold visible to the naked eye.

Nevada is being widely searched for gold, as evidenced by many reports. The North end of the Comstock lode is the scene of renewed activity, according to statements issuing from Virginia City. Consolidated Virginia & Andes Mining, recently formed in California, plans to prospect for an extension of the lode into Consolidated Virginia property. Old records are said to indicate that this section of the lode has never been extensively explored. Installation of an electric hoist has been started, and a crosscut is planned from the 500 level of the old Andes mine. C. E. Egan, of New York, is in charge of operations. Rich ore is reported found by prospectors in the old Farrell district, north of Lovelock, Nev.

According to a report from Winnemucca, Nev., what is believed to be an old lost mine has been discovered on Leonard Creek, and a rush has been started to the district. This deposit, said to be very rich, is thought locally to be the Lame Charlie or Mormon Joe mine. Both of these men were widely known prospectors in this section of Nevada 50 years ago, and used to appear at the various camps in the district with rich gold ore, but no information as to the source of the same. They have been the cause of much fruitless prospecting on the part of succeeding generations.

Reports from Deadwood, S. D., state that the present scene resembles greatly the famous rush to the Black Hills in 1876. French Creek, Potato Gulch, and Bear Creek are the sites of greatest activity. All manner of placer extraction methods are in evidence, the favorite being the prospectors' pan. Men working over these old deposits claim that they are making good wages at it.

A strike of high-grade ore is reported as having been made in the farm of C. J. C. Shields, in St. Louis County, Mo. Mr. Shields is said to be using a sluice for the recovery of the yellow metal.

The American Fork district of Utah has been the source of many reports employing high assays and extravagant adjectives. However, some activities in the search of gold seem to be taking place in this section, too.

A gold strike has been reported near Aberdeen, Inyo County, Calif.

Reports of a gold discovery near Kabayan, about 25 miles northeast of Baguio, Mountain Province, Philippine Islands, are stated to have started a rush to that district. No details are as yet available as to the size or nature of the strike.

A strike of high-grade gold ore is reported from the Altar district, Sonora, Mexico. It was made in the Old Victoria mine, which was recently acquired by B. B. Buckeridge, of Fort Worth, Tex., and has been idle since the Villa revolution.

Ontario is also being combed extensively for the precious metal, both by established companies organized for the purpose and an increasing number of individuals. A group of claims north of the Ashley Gold deposit, in Bannockburn Township, being explored by Garvish Extension Syndicate, is reported to contain a vein showing free gold. A gold find is reported from Loon Skin Lake, in the Goudreau-Michipicoten district, on a line between Hawk Junction and Michipicoten Harbor. Atlas Exploration is reported interested to the extent of an examination in the near future.

Described as the "richest gold showing" ever found in the Province of Ontario, a new discovery has found a prominent place in the news columns as a result of the appearance in Toronto of J. A. Monroe, old-time prospector, with spectacular samples of quartz heavy with free gold. The samples came from test pits on a vein on MacKenzie Island, about four miles from the Howey mine in Red Lake. Associated with the discovery was Fraser D. Reid, at present general manager of the Howey, who had an opportunity of inspecting the find and promptly optioned the claims for Coniagas Mines, Ltd., of which he is also general manager and consulting engineer. A program of surface development and diamond drilling is contemplated immediately. The vein is said to have been opened up for a total length of 750 ft., with spectacular showings of free gold in test pits and trenches to a depth of 15 ft.

Northern British Columbia, according to a dispatch from Victoria, also has a rich gold find. M. C. Brown, a veteran prospector, has filed several claims on a tributary to the Finlay River.

According to recent reports, the commerce department of the government of New Zealand, at Wellington, is conducting tests on gold-bearing gravel from a claim near Laurence, Otago, with a view to its commercial possibilities. Preliminary tests are said to have been eminently satisfactory. The deposit is

A corner of the Larkinville alluvial field, near Kalgoorlie, Western Australia. Intensive prospecting has followed the discovery there of the largest gold nugget ever found in Western Australia.

known to be of large extent and low grade.

Reports from several parts of Queensland, Australia, indicate that that province is being thoroughly searched for gold. The city of Bendigo, Victoria, Australia has established a grant from an unemployment fund for the benefit of prospectors for gold. The entire Commonwealth of Australia is especially interested in gold mining at present because of the Commonwealth Government bounty on excess gold production.

Southern Rhodesia is in the throes of a gold prospecting boom, and in almost every district of the colony claims are being pegged or re-pegged, and abandoned properties are being reopened. For several years the gold output of Southern Rhodesia has been dwindling, and no one expects any large and rapid expansion of production; nevertheless, considerable interest in the gold-mining industry has been revived, and the intensification of prospecting should yield something. The Victoria Prospecting Company is seeking a concession in the Gatooma district.

■

Construction of Yankee Mines Tramway Half Completed

Construction of the 4¼-mile cable tramway at the Yankee mine, American Smelting & Refining subsidiary in the American Fork district of Utah, is now about half finished. Starting at an altitude of 9,200 ft. at the mine, the tramway crosses the range between Major Evans and Mary Ellen gulches at 10,030 ft. In crossing Major Evans gulch, there will be one 4,000 ft. span without towers, where the buckets will travel about 700 ft. above the bottom of the canyon. The tramway is being built by the Riblet Tramway Company of Spokane, Wash., under the direction of B. C. Riblet, president and manager. For the conveyance of men and materials over the tram right-of-way, a pioneer drive is used, that eliminates the need for teaming and much manpower. Power for the pioneer drive is supplied by a Ford 36-hp. industrial engine, operating a 42-in. reversible grip wheel around which travels the endless steel cable used to carry materials ahead of the tramway.

In establishing a distant station, a ½-in. steel rope, called the "straw-line," is carried ahead by one or two men and fastened to a tree or rock. The ⅝-in. line is next hauled out and made fast. This line is used to carry men and materials on a special carrier. Most of the concrete foundations are cast at the lower station and hauled out. All of the steel for towers is fabricated here before being loaded on the pioneer drive line. As fast as the towers are completed, the straw-line is used to establish new stations ahead. Thirty towers, ranging in height from 15 to 45 ft. high, will support the 8½ miles of 1-in. endless cable for hauling ore buckets and the ¾-in. steel cable for returning buckets. Four intermediate tension stations will be built to equalize tension along the line. In the Evans peak station, just back of the mine, there will be 80 ft. of curved rail. Carriers will be of the self-dumping, double-truck, double-grip type, made by the Riblet Tramway Company,

Monument to John G. Kirchen

carrying 1,000 lb. per bucket. These will travel 600 ft. a minute, giving the tramway a capacity of 15 tons an hour.

The cables were made by the Williamsport Wire Rope Company, Timken bearings are used throughout on many parts. A 25-hp. slip-ring motor will be used at the mine for control. Gravity will pull the empty buckets back to the mine. The motor will regenerate itself when used as a brake. To insure the safe operation of the tramways, a number of devices will be installed. One of these is a tension indicator set at the lower end of the tramway, consisting of a calibrated spring set in a cage of four ⅞-in. bolts. Tramway cables are threaded in the cage so that they pull on the spring. A sixteenth of an inch variation in the length of the spring indicates approximately 100 pounds of tension. This multiplied by the number of cables gives the total amount of tension, which can be increased or reduced. At each tension station, a two-screw winch is installed so that tension can be easily adjusted by one man.

Completion of this tramway early this fall will enable A. S. & R. to operate its Yankee mine all winter without the usual three or four month layoff caused by bad road conditions. A 7-mile haul by team mill be eliminated. Ore from the lower 150-ton ore bin will be hauled by motor trucks to Pleasant Grove, 12 miles distant, and shipped to the Garfield smelter of the company.

■

Hecla Passes $20,000,000 Mark with September Dividend

Hecla Mining Company directors at a meeting on Aug. 11, declared a quarterly dividend of 10c. per share, payable in September. This disbursement, amounting to $100,000, makes the dividends paid since the initial one in 1900 total $20,005,000. Further business at the same meeting included the election to the board of directors of A. W. Witherspoon, of Spokane, to fill the vacancy created by the recent death of W. J. C. Wakefield, former vice-president. L. E. Hanley, secretary and mine superintendent, was elected to the post of vice-president.

Dedicate Kirchen Monument

A monument to the memory of John G. Kirchen, president and general manager of Tonopah Extension Mining, Tonopah, Nev., has been finished and dedicated, and his ashes have been scattered to the winds, in accordance with his wish. The monument, composed of samples of ore from every orebody from surface to the 1,800 level of the Tonopah Extension Mine, is set in a concrete bed 3½ ft. square and rises 9 ft. from base to apex. A large sample from the Denver orebody, the last one discovered by Mr. Kirchen, crowns the monument, which is located about 2½ miles west of Tonopah, and in vertical line directly above the latest discovery on the 1,800 level. The only inscription is on a bronze plaque embedded in the face of the monument. It simply bears his name, and the dates 1874—1931.

The scattering of his ashes was made a very simple ceremony attended only by members of the family and a few intimate friends. Rev. Richard L. Waddell gave a short address and with the words "Dust unto dust thou shalt return," scattered the ashes to the wind.

■

Senator Pittman Returns from Orient; Discusses Silver

United States Senator Key Pittman, of Nevada, just returned from an investigation of trade conditions in the Orient, was the guest of many San Franciscans, Nevadans, and mining men at a luncheon at the Commercial Club, San Francisco, on Aug. 12. The Senator discussed the causes for the recession of American trade with China and ascribed it principally to the drastic fall in the price of silver which diminished the purchasing power of Oriental nations by over one-half of the normal amount. Furthermore, by reason of the fact that China placed her custom duties on a gold basis unit, China has now a higher tariff than any other nation, and this acts as an additional barrier to foreign trade.

Senator Pittman maintained that there was never an overproduction of silver, but that the fall in price was the result of India's dumping silver upon the London market. The debasing of silver coinage and the sale of silver by other nations were also factors, he said. In spite of Sir George Schuster's promise to discontinue the invasion of the silver market, Pittman said: "He sold and sold."

Senator Pittman expressed the conviction that many of the bankers of China and some of the biggest bankers and men of the British Isles are as anxious for the settlement of the silver difficulties as are our own people. He pointed out that Mexico, South America, and Central America are also affected to a certain degree. It is an economic problem, pure and simple, he declared. Every country in the world wants quick action on this question. In concluding, the Senator said that, though President Hoover refrained from following the resolution of Congress calling for an international conference upon the status of silver because of the fear that questions of war debts might be raised, no anxiety or fear on this account is now possible.

Wiluna Results Disappointing; Operations Being Investigated

(By Special Cable to "E.&M.J.")

London, Aug 18.—Wiluna Gold, operating a gold property near Meekatharra, Western Australia, is not producing results expected of operations by this time. Production started in April of this year. The company claimed positive ore reserves at the end of 1929 of over 1,400,000 long tons with an average value of 39s., giving 29s. recovery with an 83 per cent extraction, and expected costs not exceeding 19s. when the plant should achieve its rated capacity of 40,000 tons monthly. July recovery was only 22s. excluding exchange premium, and costs totaled 24s. 6d. The monthly tonnage milled during the first three months' operations averaged 24,200 tons. Failure to achieve capacity was blamed in a report made in July to power plant trouble. In a recent statement the management admitted that the plant is incapable of treating 40,000 tons, because of a lack of tube mills, and stated that the output has been limited to 30,000 tons, mostly West lode ore, which is richer, although heretofore believed more refractory than that from the East lode.

. . . . The apparent discrepancy between expected and actual recovery may be due to errors in original sampling or to metallurgical difficulties but is probably because of insufficient allowance for dilution of ore with waste rock. Carl O. Lindberg, consulting mining engineer, of New York, has arrived in Australia to make an exhaustive report on Wiluna operations.

. . . . Bisichi Tin, operating an alluvial tin property in the Bisichi Valley, Bauchi Province, Northern Nigeria, reports having made a working profit of £10,330 during 1930, despite the fact that 863 long tons of concentrate was produced, realizing only 88 lb. per ton. The proved reserves of the company approximate 10,000 tons of concentrate, and the company has a strong financial position.

. . . . Consolidated Diamond Mines of South-West Africa, Ltd., operating practically all of the principal producing diamond mines in the South-West Protectorate, has decided to omit its semi-annual dividend on the cumulative preference shares. The dividend was due on Aug. 15. The company is operating at a greatly reduced rate.

. . . . Mapeke Asbestos Mines, Ltd., operating an asbestos property in the Mashaba district of Southern Rhodesia, reports a loss of £14,092 for the year ended June 30, 1931. This loss, added to a carried-over debit of £3,171 resulting from the previous year's operations, makes a total debit balance for the company of £17,263.

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Roan Antelope July Production Announced; Third Unit Started

(By Special Cable to "E.&M.J.")

London, Aug. 19.—During July Roan Antelope Copper Mines, Ltd., first of the large-scale Northern Rhodesian copper producers to swing into production, treated 75,500 short tons of ore, with an average copper content of 3.71 per cent. Production of concentrate for the month totaled 3,645 tons, assaying 58.45 per cent. A comparison with similar figures for the month of June shows the rate at which new productive capacity is being completed. Tonnage treated in June was 39,175, and 2,225 tons of concentrate was produced. The third unit of the concentrator was put into operation on July 25, just one month after the completion of the second unit.

. . . . D. D. Irwin, general manager of Roan Antelope, sailed last week for New York on a vacation trip.

. . . . Construction is well abreast of schedule both at the Rhokana and Mufulira properties. The main power plant at Mufulira has been completed, and steel on all other structures is being erected within two days following its arrival at the property.

. . . . Luiri Gold, Northern Rhodesian gold producer, reports having treated 1,040 tons of ore from the Dun Robin vein, with a recovery of metal valued at £4,385, a considerable increase over the results of the last few months.

. . . . Trepca Mines, lead-zinc producer operating in Yugoslavia, treated 22,651 metric tons of ore during July, and is reported to be making a good profit. Concentrate produced during July totaled 3,899 tons assaying 75 per cent lead and 29 oz. silver per ton, and 2,916 tons assaying 50.8 per cent zinc.

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BRIEF NOTES

Ashanti Output at New High. Ashanti Goldfields, Ltd., largest producer on the Gold Coast, Africa, and one of the three lowest cost large gold mines in the world, set a new high record for a month's output of fine gold in July, according to the company's monthly report, with a total of 14,463 oz. Development totaling 678 ft. was driven during the month. Crosscut No. 9 SW, on No. 18 level, cut the Côte d'Or reef for a width of 13 ft., through ore of an average assay of 24.5 dwt. in gold per ton.

C. & H. Tries Electric Blasting. Calumet & Hecla Consolidated, Michigan copper producer, is experimenting with electric blasting equipment, which is being tried out in the Red Jacket shaft. It operates without the use of fuse, and is proof against premature explosions. Owing to the emphasis placed on safety-first practices, however, the danger of premature explosions has been largely minimized in the mines of the district in recent years.

Tetiuhe Shareholders Meet. A meeting of shareholders in the Tetiuhe Mining Corporation, Russian lead-silver-zinc concessionaire, was called for Aug. 18 in London, to authorize the directors of the corporation to conclude negotiations with the Soviet government for the termination of the concession, and the return of its properties to the Soviet. The corporation, of which Chester Beatty is chairman, was formed in 1925, and has a concession in the Pimorsky district. Low metal prices now existing prevent profitable operations. Although no information is available of the terms being arranged, a return in bonds and cash is rumored.

Magma Lengthens Shutdown. Magma Copper has decided to lengthen the period of its shutdown, originally scheduled for six weeks. The mine, mill, and smelter, in the Superior district of Arizona, will suspend production until Oct. 1, or about three months. According to H. E. Dodge, treasurer, this decision to extend the inoperative period is based on the management's belief that radical action must be taken to reduce production before the copper industry can regain prosperity. Half-time work will be given to all employees until Sept. 16, according to William Koerner, general manager. Production costs in the second quarter of this year amounted to 8.7c. a pound.

Mount Isa Output Up. During the month of July, the second full month of operations, Mount Isa, the new Queensland lead producer, reports production of 2,211 tons of lead bullion, compared with 783 tons produced in June. The company reports milling 38,676 tons of ore, which compares with 26,630 tons, the total for the previous month.

Nevada Con. Recovery Up. Nevada Consolidated Copper reports an average recovery, in the form of concentrate, from all company material milled during the second quarter, of 21.67 lb. of copper per ton treated, compared with 20.90 lb. recovered in the previous quarter. The average tonnage of company ore treated daily during the second quarter was 17,115 tons, as compared with 17,459 tons per day in the first quarter of this year. The net cost per pound of copper produced, before depreciation and federal taxes, was 8.26c. This compares with a cost of 8.88c. for the preceding quarter.

San Francisco Incurs Loss. In June San Francisco Mines of Mexico, one of the largest of Mexico's lead-zinc producers, operated at a loss for the first time since the depression set in. Production from the property at San Francisco, Chihuahua, during the month was 3,447 metric tons of zinc concentrate and 3,409 tons of lead concentrate from 31,150 tons of ore—about the normal output in recent months. Estimated operating loss was $37,991.

Tintic Property Hires Men. Another shift has been added to the working force at the Eagle & Blue Bell mine of the United States Smelting, Refining & Mining Company. The property, in the Tintic district of Utah, was reopened last month, and at that time only one shift was put to work. The compressor is expected to be in shape for work within a few days and the new development program will start in earnest. Since reopening, the Victoria unit has shipped three cars of ore.

Vena Madre Unwaters Mine. The unwatering operations at the South Jackson gold property of Vena Marde Metals has been started. A 100-g.p.m. electric sinking pump has been installed. The property is on the Mother Lode, near Jackson, Calif.

Wonder Lessee Ships Ore. L. J. Bacoccina, leasing in the old Wonder mine at Wonder, Nev., has shipped his seventh carload. Ore to date has been drawn from the 200 level. Previous shipments have returned $10 in gold and about 30 oz. silver per ton.

MARKET AND FINANCIAL NEWS

Refined Copper Stocks Increased in July

Stocks of refined copper in the hands of North and South American producers increased 26,943 tons during the month of July, owing chiefly to a further contraction in shipments, both foreign and domestic. Blister stocks were reduced by 8,593 tons, leaving a net gain in total stocks of 18,351 tons.

Mine production in the United States fell to 38,606 tons, a decrease of 5,867 tons. Production of refined in North and South America was reduced by 1,867 tons during July.

Summary of Copper Statistics

In Tons of 2,000 Pounds

Production:	June	July
Mines, United States	44,473	38,606
Blister, North America (a)	65,110	60,066
Blister, South America (a)	24,785	24,611
Refined, No. & So. America	98,275	96,408
World, blister basis	126,722	.....
Stocks (end of month):		
No. and So. America:		
Blister (b)	187,353	178,761
Refined	413,474	440,417
Totals	600,827	619,178
Great Britain (c)		
Refined	18,389	21,423
Other forms	1,382	1,243
Totals	19,771	22,666
Havre	12,073	10,252

(a) Includes direct-cathode copper. (b) Includes in process. (c) Official warehouse only.

U. S. Mine Production

	June	July
Porphyry mines	18,312	18,187
Lake mines	5,422	3,692
Vein mines	18,313	15,127
Custom ores	2,426	(a) 1,600
Total crude production	44,473	38,606
Daily rate	1,482	1,245

(a) Partly estimated.

Smelter Production

	June	July
United States	51,652	46,503
Canada	9,591	9,837
Mexico	3,867	3,726
Totals	65,110	60,066

Shipments

North and South America

	Export	Domestic	Total
1930			
January	30,358	69,932	100,290
February	29,597	61,879	91,476
March	30,523	73,644	104,167
April	29,196	50,017	79,213
May	49,115	75,760	124,875
June	44,818	71,887	116,705
July	42,466	75,436	117,902
August	38,319	56,810	95,129
September	37,873	65,169	103,042
October	38,246	75,703	113,949
November	45,051	62,693	107,744
December	39,169	69,854	109,023
Total	454,731	808,784	1,263,515
1931			
January	45,597	60,209	105,806
February	39,415	60,636	100,051
March	36,797	74,685	111,482
April	32,218	54,567	86,785
May	26,684	45,265	71,949
June	33,251	50,217	83,468
July	26,321	43,144	69,465

Tri-State Mine Costs Down

Cost of producing a ton of lead and zinc ore in the Tri-State district is now 44 per cent less than it was five years ago, according to the Tri-State Lead & Zinc Ore Producers' Association. Royalty cost is down 61 per cent, labor costs have dropped 51 per cent, repair costs 48 per cent, explosive costs 33 per cent, office expenses 24 per cent and power costs 21 per cent. As a result of the many mine fires, the cost of fire and tornado insurance has increased 33 per cent.

In 1926, production was running around 15,000 tons weekly, against about 5,000 tons at present. Five years ago 300 drill rigs were running, blocking out further orebodies; at present none are operating. The Tri-State area is reputed to have produced in the last 40 years more than $1,000,000,000 worth of lead and zinc.

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Vanadium Corp. of Am.

Operating profit of Vanadium Corporation of America and subsidiaries dropped almost to the vanishing point in the first half of 1931, being $37,789, compared with $845,883 a year ago. Net sales were $1,572,852; costs and expenses, $1,535,063. Other income amounted to $69,091. A total of $159,589 was written off for depreciation, taxes, and other charges, and $77,127 for interest, leaving a net loss of $129,836, compared with a profit of $1,250,237 in the first half of 1930. Dividends of $274,977 paid in 1931 bring the deficit to $404,813, but dividends have now been discontinued. Capital stock outstanding amounts to 378,367 no-par shares. Current assets on June 30 were $7,093,114, including $889,275 in cash; and liabilities were $270,249.

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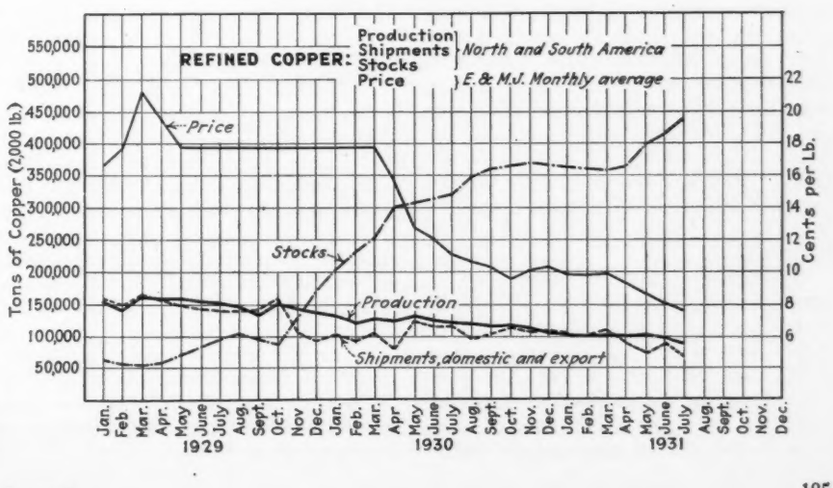
Financial Notes

BUNKER HILL & SULLIVAN reports operating profit for six months ended June 30, 1931, of $607,628 before depreciation and depletion, against $1,362,517 in first half of 1930. Operating profit in June was $140,944, compared with $16,117 in May, and $181,696 in June, 1930.

PARK UTAH CONSOLIDATED and Ontario Silver wound up the first half of the year with a loss of $227,336 after ordinary taxes and depreciation, but before depletion, comparing with a loss of $49,256 in the first half of 1930. Depreciation allowance was $52,800 in the first half of 1931, leaving an operating loss of $174,536. Ore sales were only $264,454, compared with $830,810 in first half of 1930; expenses dropped off from $829,535 to $481,882.

ALASKA JUNEAU, for the seven months ended July 31, 1931, estimates profit at $979,050 before depreciation and federal taxes, comparing with $516,350 in the first seven months of 1930.

DOME MINES' production in July was valued at $299,280, compared with $328,700 in June, $300,390 in May, and $320,626 in July, 1929.



Phelps Dodge and C.&A. to Vote on Merger

Special meetings of stockholders of the Phelps Dodge Corporation and the Calumet & Arizona Mining Company will be held on Sept. 21 to vote on the proposed merger of the two companies. At the Phelps Dodge meeting stockholders will also be asked to vote on the proposed increase in capital stock from 3,000,000 shares of $25 par value each to 6,000,000 shares, and to add to the number of directors to give representation to Calumet & Arizona.

In a letter to stockholders of Phelps Dodge, L. S. Cates, president, said:

"Investigations carried on for eighteen months by engineers and committees representing the two managements had shown that the merger was not only economically sound, but was also desirable and constructive from the standpoint of the copper industry.

"Phelps Dodge has been making plans to bring the large clay orebody into production at Morenci. This deposit, though not yet equipped, will eventually be one of the large low-cost copper producers in the world. If a consolidation is made, the clay orebody can be held in reserve, and its development can be deferred. In the meantime, the merged companies can obtain low-cost production from Bisbee and Ajo. Altogether, the combined properties allow a much more flexible and profitable operating program than would be possible if they were operated independently.

"As a result of the combination the very large ore reserves from which the combined company will be able to produce low-cost copper for many years, combined with its fabricating and marketing facilities, will make possible greater returns to you in dividends than can be expected under a continuance of the present independent operation."

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United States Lead Stocks Reduced During July

Lead statistics for July disclosed another reduction in stocks, resulting from the restriction in output and a gain in shipments. The decline in stocks amounted to 5,740 tons, which, together with a reduction of 2,672 tons in the preceding month, brings the total 8,412 tons below the peak of last May. Stocks of refined lead at the end of July totaled 133,958 tons, according to the American Bureau of Metal Statistics.

Production was held down close to the figure reported for June. The daily rate for July was 1,037 tons, against 1,024 tons in June, 1,275 tons in May, and 1,663 tons in July of last year.

Included in the production of refined lead for July are 2,218 tons of antimonial lead. Total stocks at the end of the month include 6,298 tons of antimonial, against 7,702 tons a month previous. Refined lead statistics for June and July follow:

United States Lead Statistics

In Short Tons

Production:	June	July
From domestic ore	30,708	32,157
Secondary and foreign	3,683	4,409
Totals	34,391	36,566
Stock at beginning (a)	142,370	139,698
Total supply	176,761	176,264
Stock at end (a)	139,698	133,958
Shipments by difference	37,063	42,306
Shipments reported	37,054	42,219

(a) Domestic only.

Industrial classification of domestic lead shipments for May, June, and July, in tons, follows:

	May	June	July
Cable	8,433	8,877	10,72
Ammunition	1,609	1,328	2,210
Tin foil	510	1,233	1,597
Batteries	3,762	3,467	4,363
Brass-making	176	235	138
Sundries	1,817	2,677	2,397
Jobbers	228	346	378
Unclassified (a)	17,546	18,891	20,410
Totals	34,081	37,054	42,219

(a) Of the shipments reported as unclassified abou one-third moves normally into white lead and abou 30 per cent into red lead and litharge, as averages, but it is impossible to make a monthly segregation of the shipments according to these destinations. Other important manufactures are sheet and pipe, solder, and babbitt metal.

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International Nickel Earnings

International Nickel Company of Canada, Ltd., reported net earnings in the quarter ended June 30, after taxes and provision for depreciation and depletion, were $1,700,248, equivalent after preferred dividends to 8c. a share on the common stock. This compares with net earnings of $3,267,730, or 20c. a share, in the corresponding quarter of 1930.

In the six months ended June 30 the company's net earnings were $3,359,886, or 16c. a share, on the common stock, against $7,883,874, or 50c. a share, in the first half of 1930.

United States Zinc Statistics

(American Zinc Institute)

In Short Tons

1931	Output	Shipped	Stock End of Month	Export (a)	Retorts Operating End of Mo.	Average Retorts Operating	Unfilled Orders	Daily Rate of Production
January	32,522	31,064	145,076	1	35,635	35,137	30,251	1,049
February	29,562	30,249	144,389	0	35,518	36,823	33,453	1,056
March	32,328	35,224	141,493	0	34,221	33,047	31,216	1,043
April	29,137	27,418	143,212	0	29,072	29,165	36,150	971
May	25,688	25,851	143,049	20	23,024	23,032	31,146	829
June	23,483	27,604	138,928	0	21,422	22,298	33,086	783
July	21,365	28,460	131,833	20	21,666	20,320	24,815	689

(a) Exports are included in total shipments.

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Silver Production

(American Bureau of Metal Statistics)

In Thousands of Ounces

	Jan.	Feb.	March	April	May	June	July
United States	3,480	3,187	3,528	2,831	2,762	2,433	2,207
Canada	1,932	1,772	1,431	1,139	1,836	731	2,133
Mexico	8,751	6,944	6,510	(a)9,535	7,374	7,041	(b)
Peru	918	1,047	1,056	1,215	1,389	1,145	1,063
Australia	695	657	689	683	638	558	633
Burma	540	530	530	530	470	510	(b)

(a) Revised. (b) Not yet available.
The above countries produced about 87 per cent of the world's output of silver in 1930.

U. S. Graphite Production Declined During 1930

The total quantity and value of graphite sold by graphite miners in the United States in 1930 were considerably smaller than the corresponding figures for 1929, according to the U. S. Bureau of Mines. The sales of natural amorphous graphite by producers in 1930, were 1,941 tons, valued at $20,525. In comparison with 1929, there was a decrease of 1,641 tons, or 45 per cent in quantity, and of $26,125, or 56 per cent in value. Because only two operators reported sales of crystalline graphite in 1930, it is impossible to publish figures without disclosing confidential information. Statistics of sales of graphite were collected in cooperation with the geological surveys of Alabama and Michigan.

The states reporting the sale or use of graphite by the miner in 1930 were Alabama, Michigan, Nevada, and Rhode Island. Alabama was the only State reporting sales of crystalline graphite in 1930.

The foregoing figures represent the sales or shipments of graphite. The production figures are somewhat different. Only one amorphous graphite mine was in operation in 1930, that operated by Carson Black Lead, in Nevada.

The imports of graphite in 1930 amounted to 16,726 short tons, valued at $531,642, in comparison with 24,072 short tons, valued at $1,066,834, in 1929.

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NEW JERSEY ZINC'S net profit for first half of 1931 was $1,726,021 after charges and taxes, equal to 88c. a share on common, comparing with $3,089,155, or $1.57 a share, in same period of 1930. A deficit of $237,243 remained after paying dividends. Profit in second quarter was $865,252, practically the same as $860,769 in the first quarter.

Secondary Metal Output in 1930 Dropped Sharply

A study of figures issued by the U. S. Bureau of Mines indicates that 926,471 short tons of copper, lead, zinc, tin, antimony, aluminum, and nickel was recovered from scrap or residues or utilized from such material in alloys or chemical compounds in 1930. The total was 281,511 tons, or 23 per cent below the record high figures of 1929. Copper recovery dropped 24 per cent, lead 18 per cent, zinc 26 per cent, tin 24 per cent, antimony 28 per cent, aluminum 20 per cent, and nickel 33 per cent. The value of these metals recovered decreased over 40 per cent as compared with the preceding year. The total value of all recovered or re-utilized scrap and residues, except that used in zinc chemical compounds for which no figures are given, was $193,255,100.

Copper recovered as metal dropped 53,800 tons, totaling 244,800 tons, and copper reclaimed in alloys other than brass equaled 88,000 tons, a decline of 32,000 tons. Just about half of the drop in the recovery of copper as metal is attributed to copper refinery output from scrap, which declined to 140,270 tons from 167,079 tons in 1929. This figure, however, was above the 1928 record of 116,323 tons. Copper recovery from new scrap dropped 51,000 tons, to 62,000 tons, but that from old scrap declined only 34,500 tons, to 270,100 tons. Including the copper content of brass scrap melted as ingot, estimated on an average of 70 per cent for both red and yellow, the total secondary copper recovered was 467,200 tons, compared with 626,550 tons in 1929. Brass remelted declined from 298,500 tons to 192,000 tons, or 36 per cent. As in copper scrap, the bigger decline was in new scrap, due undoubtedly to the low operations of industrial and metal fabricating plants. New brass scrap remelted declined from 156,000 tons to 89,000 tons, and old scrap from 142,500 tons to 103,000 tons.

More secondary lead was recovered as lead in 1930 than was recovered in remelted alloys. The reverse was true in preceding years. Lead recovered as lead by secondary refiners was actually higher than in the preceding year. Zinc recovered as zinc showed a sharp drop, equaling 34,849 tons from redistillation, compared with 47,348 tons in 1929, and 14,451 tons from sweating, remelting and similar operations, compared with 18,052 tons in 1929. Estimated zinc recovery in brass, which was above output of zinc as metal in 1929, dropped below the latter. The secondary zinc content in lithopone increased from 12,871 tons in 1929 to 14,678 tons, but decreased in other zinc chemicals.

Although secondary tin recovery dropped last year, de-tinners of new tin-plate scrap increased output and re-utilization about 200 tons. Treating 208,282 long tons of tin-plate clippings, 13,400 tons less than in 1929, they nevertheless brought up their recovery from 31.9 lb. tin per long ton to 35.9 lb. Their secondary tin recovery was 3,742 tons. Aluminum recovered as metal dropped 3,600 tons, while aluminum recovered in alloys declined to the extent of 3,400 tons.

The following table summarizes in detail secondary metal output and utilization in 1930 as compared with 1929 and 1928:

U. S. Secondary Metal Output and Recovery, 1928-1930

	1930 Short Tons	1929 Short Tons	1928 Short Tons
Copper as metal	244,800	297,600	230,000
Copper in brass (70% estimated)	134,400	208,950	211,400
Copper in other alloys	88,000	120,000	95,000
Total copper	467,200	626,550	536,400
Brass scrap remelted (a)	192,000	298,500	302,000
Lead as metal by secondary smelters	80,865	73,141	82,070
Lead as metal by primary smelters	48,135	65,359	55,930
Lead in alloys by secondary smelters	116,996	156,808	159,537
Lead in alloys by primary smelters	9,804	15,692	11,063
Total lead	255,800	311,000	308,600
Zinc as metal	49,300	65,400	70,700
Zinc in brass (estimated)	42,300	65,670	66,000
Zinc in other alloys	7,700	11,600	12,500
Zinc in chemical compounds	28,389	29,626	28,626
Total zinc	127,689	172,296	177,826
Tin as metal	5,600	7,400	8,200
Tin in alloys and chemical compounds	20,600	26,900	27,600
Total tin	26,200	34,300	35,800
Antimony at secondary smelters	6,800	9,248	10,545
Antimony at primary smelters	1,282	1,883	1,355
Total antimony	8,082	11,131	11,900
Aluminum as metal	19,700	25,850	24,500
Aluminum in alloys (mainly No. 12)	18,900	22,550	23,300
Total aluminum	38,600	48,400	47,800
Nickel as metal	500	850	635
Nickel in non-ferrous alloys and salts	2,400	3,500	3,865
Total nickel	2,900	4,350	4,500
Grand total	926,471	1,207,982	1,122,826

(a) Not included in grand total.

Tungsten Consumption Off on Drop in Steel Output

The consumption of tungsten, and usually the production, fluctuates with the rise and fall in operations in the steel industry. In the United States one short ton of tungsten concentrates is used for each 13,700 long tons of steel ingots and castings made. Therefore, the decrease of 28 per cent in the production of steel in the United States in 1930 was reflected both in the domestic shipments and imports of tungsten ore and concentrates in 1930, reports the Bureau of Mines.

The shipments of tungsten concentrates, produced in the United States, in 1930 amounted to 702 short tons, carrying 60 per cent WO_3 valued at $509,000, or $12.09 a unit, as compared with shipments in 1929 amounting to 830 short tons, valued at $654,000, or $13.13 a unit. Shipments in 1930 were 453 short tons below the average for the five years 1925 to 1929. They consisted of 647 tons of scheelite and 55 tons of ferberite, wolframite, and huebnerite. The scheelite was obtained in California, Montana, and Nevada. The ferberite was mined in Boulder County, Colo. A little wolframite was produced in Arizona and Washington, and a little huebnerite in Nevada.

Stocks of concentrate at the mines on Dec. 31, 1930, were equivalent to 560 short tons of 60 per cent WO_3.

Imports of tungsten ore and concentrates into the United States decreased in 1930. The imports in 1930 contained 3,694,894 lb. of tungsten, equivalent to 3,882 short tons of 60 per cent WO_3, as compared with imports in 1929 containing 5,973,817 lb. of tungsten, equivalent to 6,277 short tons of 60 per cent WO_3. Effective June 18, 1930, the rate of duty on tungsten ore or concentrates was increased from 45c. to 50c. per pound on the metallic tungsten contained therein.

The world prices of wolframite as reflected by London quotations ranged downward from $7.60 a short ton unit at the beginning of 1930 to $3.04 at the close of the year.

In the United States the price of tungsten concentrates was very close to the cost of foreign ore plus the duty, with scheelite nominally commanding a premium of 25c. to $1 (depending on purity) a short ton unit over wolframite. Early in January wolframite was quoted at $15.50 a short ton unit; scheelite $16.50; and Bolivian scheelite $15.50. Prices declined until near the end of October, when wolframite was quoted nominally at $12.50 a short ton unit; domestic scheelite $13; foreign, $12.50.

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Nevada Consolidated Copper

Nevada Consolidated Copper Company reports a loss for the second quarter of 1931 of $19,381, against a loss of $56,995 in the preceding quarter, and a profit of $395,212 in the first quarter of last year. Operations for the June quarter showed a loss of $428,218 from copper production. The value of precious metals recovered in that period was $203,426, and miscellaneous revenues, including income from subsidiaries, totaled $205,410.

Production of copper during the second quarter amounted to 33,009,236 lb., against 32,786,338 lb. in the first quarter of the current year.

Copper Holds at 7.50c. Despite Increase in Stocks—Demand Continues Dull

New York, Aug. 20, 1391.—Trading in non-ferrous metals has been dull in the last two weeks, but prices in the major items showed very little change. Developments in the European situation and publication of the July statistics for copper, lead, and zinc seemed to exert little influence on the price structure. The increase in the stocks of refined copper held by North and South American producers again brought home the fact that further drastic curtailment will have to be faced before very long. In view of the fact that the stocks appear to be in strong hands, no selling pressure developed. Lead was dull but well maintained as to price on the continued decline in stocks. Zinc also registered further improvement statistically, though the price eased slightly in some directions. Silver declined about 1c. per ounce. Quicksilver was offered more freely in a quiet market, and prices declined to below $80 per flask.

Copper Quiet

The copper situation is unchanged from two weeks ago, the custom smelter group offering limited quantities of metal for comparatively early deliveries at 7½c., delivered Connecticut, and the large producing groups out of the market at 7¾ or 8c. The custom smelters have had more bids for copper at 7½c. than they cared to fill, though the demand at that has been quiet.

World production of copper, by countries, for the months of June and July, in short tons, follows:

	June	July
United States	51,652	46,503
Mexico	3,867	3,726
Canada	9,591	9,837
Chile and Peru	24,785	24,611
Japan	6,970	7,014
Australia	1,296	1,271
Germany	5,161	4,698
Other Europe(a)	11,800	11,600
Elsewhere(b)	11,600	12,000
Totals	126,722	121,260

(a) Partly estimated. Includes production of blister copper in countries other than Germany, whereof Spain, Russia, and Yugoslavia are the more important. (b) Chiefly Africa.

Zinc Lower

Zinc has dropped slowly, 2½ points at a time, from the 3.90c. level of a month ago. The present price of 3.80c. was first reported Aug. 14, and practically all sales since have been at that level. Producers have tried to confine sales at that price to August-September shipment, with 2½ points premium for each month ahead.

Lead Stocks Down

The July refined lead statistics released during the week were encouraging, revealing another reduction in stocks. This development, however, brought about little change so far as activity was concerned. The tonnage sold during the last week was larger than in the preceding week, but well below the average. The undertone remained steady in all directions and prices held at 4.40c., New York, the contract basis of the American Smelting & Refining Company, and at 4.225c., St. Louis.

Tin Sales Improve

The market for tin was not active, but the sales volume was somewhat larger for the period than recently, and prices firmed up, prompt Straits selling as high as 26¼c. on Aug. 13. Both dealers and consumers were interested in near-by metal. Toward the close the market eased moderately on reports to the effect that shipments from the Straits would be larger than first estimated.

Silver Unsettled

World production of silver for June was estimated at 12,418,000 oz., against 14,469,000 oz. in May, and 18,607,000 oz. in June of last year. The market developed a slightly easier tone on selling early in the period for China account to cover imports of commodities. Germany has been reported a buyer for coinage purposes.

Foreign Exchange

Correction—The July average for Sterling exchange was 485.349, and not 485.425, as published in the issue of Aug. 10.

Other Metals

Quotations cover wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., delivered, Alcoa commercial and mill ingot, 99 and 98 per cent, 23.30c.; Alcoa No. 12 alloy, 22c.; metallurgical ingot, 94 per cent plus, 23.30c.; 98@99 per cent, 22.90c. London, £85, less 2 per cent, per long ton, for 98 per cent ingots and bars.

ANTIMONY—Per lb., duty paid, Chinese, spot, 6.60c.; futures, 6.50c. Cookson's "C" grade, spot, 11½c. "CMC." grade, 99.9 per cent, spot, 11c.

BISMUTH—Per lb., in ton lots, $1.50. London, 6s.

CADMIUM—Per lb., 55c. London, 1s. 9d.@1s. 10d.

CHROMIUM—Per lb., 97@98 per cent grade, 85@90c. per lb. contained chromium, maximum 1 or 2 per cent iron.

COBALT—Per lb.: Metal imported from Belgium, 97@99 per cent, $2.50 less 35 per cent for cash. On yearly requirements, usual rebate of 5 to 10 per cent, as to quantity. London quotes 7s., subject to usual discounts.

INDIUM—Per gram, minimum 99 per cent, $14@$15; 98½ per cent, $90@$100 per oz.

IRIDIUM—Per oz., $100@$105 for 98@99 per cent sponge and powder.

MAGNESIUM—Per lb., ingots (4x16 in.), 99½ per cent, 48c., in 100-lb. lots or more; 2½- or 3-lb. sticks (1⅛x27 in.), 53c., 100-lb. lots or more. London, 2s. 9d.@3s. for 99 per cent ingots or sticks.

MANGANESE—Per lb., 95@97 per cent, 42c.

MOLYBDENUM—Per lb., in 10- to 50-lb. lots, C.P. powder, $9; 97 per cent, $4.50. (Usually sold as calcium molybdate or ferromolybdenum, which see.)

NICKEL—Per lb. electrolytic cathodes, 35c.; shot and ingot made from remelted electro, 36c. for single lots of spot metal. London, per long ton, £170 @£175, as to quantity.

OSMIUM—Per oz., $60@$65.

PALLADIUM—Per oz., $19@$21. London, £3 12s. 6d.@£4.

PLATINUM—Per oz. Official price of leading interest $40. Cash transactions between dealers and refiners at $2 less. London official price £8. Average price of Colombian crude for July, basis 85 per cent platinum, was $29.50.

QUICKSILVER — Per 76-lb. flask, $78@$80. Business was quiet and there were sellers at slightly lower levels.

RADIUM—Per mg. radium content, $50 in lots of 4 grams or more, to $65 for 1 gram; smaller quantities, $70.

RHODIUM—Per oz., $45@$50.

RUTHENIUM — Per oz., $40@$45.

SELENIUM—Per lb., $1.80@$2, depending on quantity, for black, powdered, 99.5 per cent pure. London, 7s. 8d.@7s. 9d.

SILICON—Per lb., minimum 97 per cent Si, maximum 1 per cent Fe, 15@17c.

TANTALUM—Per kilo, $91 for C.P. bar or sheet.

TELLURIUM—Per lb., $2. London, 9s. 6d.

THALLIUM—Per lb., $12.50@$15.

TITANIUM—Per lb. in 50- to 100-lb. lots, 75 per cent, $5.

TUNGSTEN—Per lb. contained tungsten, 98 per cent, powdered, $1.45.

Metallic Ores

Prices in tons of 2,000 lb., or in "units" of 20 lb., unless otherwise stated.

ANTIMONY ORE—No sales reported. London, per long ton unit, 3s.@3s. 6d. for 60 to 65 per cent sulphide ore.

BERYLLIUM ORE—Per unit of BeO, minimum 11 per cent BeO, $4@$5, f.o.b. mines. Per lb. BeO contained, 40c., c.i.f. European ports. Nominal.

CHROME ORE—Per long ton, c.i.f. Atlantic ports, Indian ores, $17 for 46@48 per cent Cr_2O_3 ore, and $19.50@$20 for 50@51 per cent ore. London, 74s. to 75s. for 48 per cent Rhodesian, and 77s.

Daily Prices of Metals

Aug.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
6	7.275	24.35	4.40	4.225	3.85
7	7.275@7.525	24.85	4.40	4.225	3.85
8	7.275	25.00	4.40	4.225	3.85
10	7.275	25.125	4.40	4.225	3.825
11	7.275	25.075	4.40	4.225	3.825
12	7.275	26.00	4.40	4.225	3.825
Av'ge	7.296	25.067	4.400	4.225	3.838
13	7.275	26.25	4.40	4.225	3.825
14	7.275	26.20	4.40	4.225	3.80
15	7.275	26.125	4.40	4.225	3.80
17	7.275	26.00	4.40	4.225	3.80
18	7.275	25.70	4.40	4.225	3.80
19	7.275	25.60	4.40	4.225	3.80
Av'ge	7.275	25.979	4.400	4.225	3.804

Average prices for calendar week ended August 8, 1931 are: Copper, 7.338c.; Straits tin, 24.650c.; New York lead, 4.400c.; St. Louis lead, 4.225c.; Zinc, 3.850c.; Silver 27.917c.

Average prices for calendar week ended August 15, 1931 are: Copper, 7.275c.; Straits tin, 25.796c.; New York lead, 4.400c.; St. Louis lead, 4.225c.; Zinc, 3.817c. Silver, 27.146.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East and Middle West is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold, London	Aug.	Sterling Exchange "Checks"	Silver		Gold, London
		New York	London				New York	London	
6	4.84 3/4	27 7/8	13 1/16	84s11½d	13	4.85¼	27⅛	12 5/8	84s11½d
7	4.84½	27 3/4	12 15/16	84s11½d	14	4.85¼	27⅛	12 5/8	84s11½d
8	4.84 3/4	27½	12 13/16	.....	15	4.85¼	27⅛	12 5/8	.....
10	4.85⅛	27⅛	12 9/16	84s11½d	17	4.85 5/16	27⅛	12 5/8	84s10d
11	4.85 3/16	27⅛	12 5/8	84s10 5/8d	18	4.85 3/8	27¼	12 11/16	84s11 3/8d
12	4.85¼	27¼	12 5/8	84s11½d	19	4.85½	27¼	12 11/16	84s11 3/8d

Average for week ended August 12: Silver, 27.438c.; Sterling Exchange, $4.84927.

Average for week ended August 19: Silver, 27.167c.; Sterling Exchange, $4.85323.

New York quotations are as reported by Handy & Herman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command nine-thirty-seconds of a cent premium.

London

Aug.	Copper Standard		Electrolytic (Bid)	Tin		Lead		Zinc	
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
6	32 11/16	33 9/16	35	108½	111	12⅛	12 5/16	11	11 11/16
7	32½	33 7/16	35	110½	113⅛	12 3/16	12 7/16	11 3/8	12
10	32½	33 7/16	35	112½	115	12⅛	12⅜	11 3/8	12
11	32 5/16	33 3/16	35	111 5/8	114⅛	11⅞	12 1/16	11 5/16	11 13/16
12	32⅜	33 5/16	35	115¼	117¾	11 13/16	11 15/16	11⅜	12 1/16
13	32 9/16	33½	35	115 7/8	118½	11¾	11 13/16	11¼	11⅞
14	32⅝	33 11/16	36	116	118½	11 5/8	11 11/16	11 3/16	11 13/16
17	32 1/16	33⅞	36	115½	118	11⅜	11 9/16	11⅛	11¾
18	32 7/16	33 5/16	35½	114⅜	116¾	11½	11⅝	11	11 5/8
19	32 7/16	33 5/16	35½	113 5/8	116¼	11⅝	11¾	11⅜	12

Prices for lead and zinc are the official price for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

6d.@87s. 6d. for Indian and New Caledonian, according to quality.

IRON ORE—Per long ton, Lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per long ton unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 10c.

Foreign ores, alongside docks Atlantic ports, cargo lots, cents per long ton unit:

North African and Swedish, low-phosphorus, 8½@9½c.

Spanish and North African basic, 50@60 per cent, 8½@9c.

Swedish foundry or basic, 65@68 per cent, 9c.

Newfoundland foundry, 55 per cent iron, 8½c. Nominal.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, cargo lots, exclusive of duty: Brazilian, 46@48 per cent Mn, 23c.; Chilean, 47 per cent minimum, 29c.; Indian, 48@50 per cent, 25@26c.; Caucasian, 52@55 per cent, 26@27c.; South African, 52@54 per cent, 25@26c.; 50 to 52 per cent, 24@25c; 44 to 46 per cent, 23½c.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, minimum 80 per cent MnO_2, Brazilian or Cuban, $60. Javan or Caucasian, 85 per cent minimum, $60. Domestic, 70 to 72 per cent, $60, f.o.b. mines.

MOLYBDENUM ORE—Per lb. of contained MoS_2, nominally 45c., delivered Pittsburgh, for 75@85 per cent concentrate. London, per long ton unit, nominal at 28s. 6d. to 30s. for 80@85 per cent concentrate.

TANTALUM ORE—Per lb. Ta_2O_5, 70c. for 60 per cent ore. Market nominal.

TIN ORE — No market in United States. London, returning charge on 60 per cent Bolivian, £8 15s.@£9 per long ton; on 70 per cent Nigerian, £6 17s. 6d., basis £200.

TITANIUM ORE — Per gross ton, ilmenite, 45@52 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$12, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Chinese wolframite, $11.25, duty paid. Bolivian scheelite, $11.50. Domestic, $12. Shipments of odd carlots do not command full prices.

VANADIUM ORE—Per lb. V_2O_5 contained, 27c., f.o.b. shipping point. London, 16 to 18 per cent V_2O_5, nominal at 45s.@47s. 6d. per long ton unit, c.i.f., on contract.

ZIRCON ORE — Per ton, 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots. Crude granular zircon. $70, f.o.b. Suspension Bridge, N. Y.; milled, $90.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.
Tons of 2,000 lb. unless otherwise noted.

AMBLYGONITE — Per ton, f.o.b. mines, 8@9 per cent Li_2O, $50@$60.

ASBESTOS — Per ton, f.o.b. Quebec mines, tax and bags included: Crude No. 1, $250@$350; crude No. 2, $200@$250; spinning fibers, $90@$175; magnesia and compressed sheet fibers, $100@$125; various grades shingle stock, $45@$65; various grades paper stock, $27.50@$35; cement stock, $15@$20; floats, $10@$12.

Per ton c.i.f. New York: Rhodesian crude No. 1, $300; No. 2, $200. Nominal.

Per ton, c.i.f. New York: Russian crude No. 1, $220@$250; No. 2, $175@$200; No. 3, $125@$150. Nominal.

Per ton, f.o.b. mines, Vermont: Shingle stock, $55; paper stock, $35; cement stock, $20.

BARIUM CARBONATE (Witherite) — Per ton, 90 per cent 200 mesh, $47; 100 mesh, $44.

BARYTES—F.o.b. mines, bags extra:

Georgia: Barytes ore, crude, $6@$6.50 per long ton.

Missouri: Per ton, water ground and floated, bleached, $23, car lots, f.o.b. works. Crude ore, minimum 95 per cent $BaSO_4$, less than 1 per cent iron, $6; 1 per cent iron and 93 per cent $BaSO_4$, $5.50, f.o.b. mines.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $6.50@$8, f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6@$7.50, f.o.b. *Arkansas* mines. Pulverized and dried, 56 to 59 per cent Al_2O_3, 8 to 12 per cent SiO_2, $10@$12.25, f.o.b. *Arkansas* mines; abrasive grade, crushed and calcined, 78 to 84 per cent Al_2O_3, $14@$16, f.o.b. *Arkansas* mines.

Per metric ton, foreign, c.i.f. Atlantic ports: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50. Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 4 per cent SiO_2, $6@$8.

BENTONITE—Per ton, carload lots, f.o.b. Wyoming mines, dried and crushed, in bulk, $8; in bags, $10. F.o.b. Chicago, selected air-floated, $25.

BORAX — Per ton, carload lots, in bags, crystals, $56; granulated, $50; powdered, $57.50; f.o.b. shipping point.

CELESTITE—Per ton in carload lots, 90 per cent $SrSO_4$, finely powdered, $27.

CHINA CLAY (KAOLIN)—Per ton, f.o.b. *South Carolina* mines, crude lump, No. 1, $5; crushed air-floated, $7; pulverized, $9@$10.

Florida, washed and crushed, No. 1, $12.50; No. 2, $12.

Delaware, No. 1, $14.50.

Imported English, f.o.b. American ports: lump, $17@$21 in bulk.

EMERY—Per ton, f.o.b. *New York,* domestic crude ore, first grade, $10. Other American ore, delivered to grinders, per gross ton, $15; Turkish and Naxos ore, $30@$35. F.o.b. *Pennsylvania,* in 350-lb. kegs, Turkish, Khasia, and Naxos grain emery, 6½c. per lb.; American, 3½c.

FELDSPAR — Per ton, f.o.b. *North Carolina,* potash feldspar, 200 mesh, white, $15, in bulk; soda feldspar, $18. F.o.b. *Maine,* potash feldspar, white, 200 mesh, $19, in bulk. Granular glasspar, f.o.b. *North Carolina,* $10.50 in bulk.

Virginia, No. 1, 325 mesh, $17; 200 mesh, $15@$16; 160 mesh, $14@$15; No. 1 glassmakers', $11; enamelers', $12.50.

New Mexico: Crude clean No. 1 potash spar, $4.75; ground, $9.50.

FLUORSPAR — Per ton, f.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $13. Foundry lump, 85-5, $15. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $30 in bulk; $34 in bags or barrels. *Colorado* mines, 82-5, $12.75.

Foreign fluorspar, gravel, 85-5, $18.50 per gross ton, duty paid.

FULLER'S EARTH — Per ton, f.o.b. *Colorado,* $18, various finenesses to minus 90 mesh.

F.o.b. *Georgia* or *Florida,* 30 to 60 mesh, $17; 15 to 30, $16; 200 up, $10; 100 up, $7.

GARNET—Per ton, f.o.b. *New Hampshire* mines: concentrate, $40; washed grades, $125.

New York: Adirondack garnet concentrates, $85.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. *Colorado:*

Brilliant black, $31.65; seconds (mine run), $25.50.

Selects, $30.50, f.o.b. Utah. Nominal.

GRAPHITE—Per lb., f.o.b. *New York:* Ceylon lump, 6½@7½c.; carbon lump, 3@6c.; chip, 5@6c.; dust, 3@4c.; Madagascar flake, 5@6c.

No. 1 flake, 8@16c.; No. 2, 5c. upward; fine ground, 3c. upward; amorphous, 3c. upward.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND — Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20.

GYPSUM—Per ton, f.o.b. mill, crushed rock, *Iowa,* $2.50; *Ohio* and *New York,* $3. Ground, *Ohio,* $4; *Iowa,* $6. Agricultural, $6@$7. Calcined, $6@$9.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

LEPIDOLITE—Per ton, $50@$60 for ordinary grades. Nominal.

LIMESTONE—Per ton, f.o.b. shipping points, depending on location, either lump or crushed, 25c.@$1.75.

Agricultural, $1 up to $6 per ton, as to grade and point of shipment.

MAGNESITE—Per ton, f.o.b. *California,* dead-burned, $25. Kiln run, 93 per cent MgO (artificial periclase), $68; 88 per cent MgO, $35. Caustic, 95 per cent MgO, $45; 90 per cent, $40. *Washington:* Dead-burned grain magnesite, $22.

MICA—Per ton, f.o.b. *New Mexico,* scrap, white, $21; off color, $18. Punch, white, for disks, per lb., 10c.; for washers, 8c.

Per ton, f.o.b. *New Hampshire,* roofing mica, $23; snow, $34; 40 mesh white, $40; 60 mesh, $48; 100 mesh $60; 200 mesh, $75. Clean dry mixed bench and mine scrap, $13.

Per lb., f.o.b. *North Carolina* Punch, 4@5c.; 1½x2 in., 25@35c.; 2x2, 45@60c.; 2x3, 85c.@$1; 3x3, $1.40@$1.60; 3x4, $1.80@$2; 3x5, $2@$2.25; 4x6, $2.75@$3; 6x8, $3.50@$3.75; 8x10, $5@$7.50. These prices apply both to No. 1 and No. 2 mica. Black-stained mica takes a discount of 10 to 25 per cent from this schedule. White North Carolina mica, 70 mesh, $60 to $80. Biotite, or black mica, $15 a ton, unground.

MINERAL BLACK—(Graphitic shale) —Per ton, 325 mesh, 75 per cent carbon $22.50, f.o.b. *Virginia.*

MONAZITE—Per ton, minimum 6 per cent ThO_2, $60.

OCHER — Per ton, f.o.b. *Georgia* mines, $17.50 in sacks; $20 in barrels; second grade, $10. Buff clay, 98 per cent through 325 mesh, $18.

F.o.b. *Virginia,* dark yellow, 300 mesh, 60 per cent ferric oxide, in jute bags, $19.50.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent,

$6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4.

Tennessee, ground lime phosphate, 80 per cent through 300 mesh, 33 per cent P_2O_5, $12.80 per net ton, bags extra.

PUMICE STONE—Per lb., in barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur, c.i.f. United States ports, guaranteed 48 per cent sulphur, Spanish, 13c.

POTASH—Per ton, contracts:

	Bags	Bulk
Muriate of potash, 80@85 per cent, basis 80 per cent	$37.15	$35.55
Sulphate of potash, 90@95 per cent, basis 90 per cent	48.25	46.65
Sulphate of potash-magnesia, 48@53 per cent, basis 48 per cent	27.80	26.20
Manure salt, 30 per cent	22.15	19.15
Manure salt, 20 per cent	15.65	12.65
Kainit, 14 per cent	12.70	9.70

Prices are delivered to Atlantic ports. Discounts up to 4 per cent for early shipment. Spot prices, $1.25@$1.50 per ton higher than on contract.

[1]QUARTZ ROCK CRYSTALS—For fusing, all sizes, $250 per ton. Prisms for piezo-electrical use, $3 per lb. in small lots. Optical grades command premium.

SILICA—Per ton, water ground and floated, in bags, f.o.b. *Illinois:* 325 mesh, $16@$40 for 92 to 99½ per cent grades. Dry ground, air-floated, 325 mesh, 92@99½ per cent silica, $14@$30. Market steady. Glass sand, f.o.b. producing plant, $1.25@$5 per ton; molding sand, 50c.@$3.50; blast sand, $1.75@$6.

[1]STRONTIANITE — Per ton, lump in carload lots, minimum 90@92 per cent $SrCO_3$, $100.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports.

TALC — Per ton, carload lots, f.o.b. works, containers included unless otherwise specified:

New Jersey: Soapstone, ground, $10@$12.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75.

Vermont: 99 per cent through 200 mesh, extra white, bulk basis, $8@$8.50; 97 to 98 per cent through 200 mesh, medium white, $7@$7.50. Packing in paper bags, $1 per ton extra.

Virginia: 200 mesh, $4.60@$8.25; 325 mesh, $8.75@$10.50.

TRIPOLI — Per ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $15. Double ground through 110 mesh, rose and cream, $17. Air-floated through 200 mesh, rose and cream, $22.50.

Metallic Compounds

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. London, per long ton, £20@£20 10s. for Cornish white. Mexican, high grade, £17 5s.@£17 10s.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 85c.

COBALT OXIDE—Per lb., black oxide, 70@71 per cent grade, $1.35.

COPPER SULPHATE (Blue Vitriol)—Per lb., in car lots, 3.60c. for either large or small crystals.

GERMANIUM DIOXIDE—Per gram, in 200- to 300-gram lots, $3.50.

SODIUM NITRATE—Per 100 lb., crude natural, in bags ex vessel, Atlantic ports, $2.05.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $16@$18.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6¼c.; French red seal, in bags, 9⅜c.

ZIRCONIUM DIOXIDE—Per lb. in 100- to 500-lb. lots, 87 per cent ZrO_2, commercial, 50c.

Refractories

CHROME BRICK—Per ton, f.o.b. shipping point, $45. Grecian refractory ore, 37@42 per cent, 40c. per unit.

FIRECLAY BRICK — Per M., first quality, $40, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35.

MAGNESITE — Brick, per ton, f.o.b. works, 9-in. straights, $65. Dead-burned grain, $40, f.o.b. Chester, Pa., or Baltimore.

SILICA BRICK—Per M., *Pennsylvania,* $40; *Alabama,* $50@$51; *Illinois* and *Indiana,* $49.

ZIRKITE—Per lb., powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

Alloys

FERROCHROME — Per lb. of contained chromium, 4 to 6 per cent carbon, 65 to 70 per cent chromium, 11c., delivered, on contracts; spot, 11½c. Containing 2 per cent carbon, 67 to 72 per cent chromium, spot, 17½c.; maximum 0.10 per cent carbon, 26c., spot; 24½c. contracts.

FERROMANGANESE — Per gross ton furnace: domestic and foreign, 78@82 per cent, $80@$85, contracts, depending on quantity. Spiegeleisen, 19@21 per cent, $30 for spot carloads.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.

FERROPHOSPHORUS—Per gross ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50, f.o.b. *Alabama* and *Tennessee.*

FERROSILICON — Per gross ton, delivered, 50 per cent, $83.50; 75 per cent, $130; 14@16 per cent, $31, f.o.b. Niagara Falls, N. Y. Spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton, $150, f.o.b. producer's plant, carlots.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1@$1.10, f.o.b. works.

FERROVANADIUM—Per lb. of V contained, delivered, $3.15@$3.50.

SILICOMANGANESE — Per long ton, carload contracts, delivered, $105 for maximum 2½ per cent carbon; $115 for maximum 1 per cent carbon.

SILICON ZIRCONIUM—Per lb., 47@52 per cent Si, 35@40 per cent Zr, 18@21c.

ZIRCONIUM FERROSILICON—Per gross ton, 12@15 per cent Zr, 39@43 per cent Si, $103.50@$108.50.

Rolled Metals

COPPER — Per lb., sheets, hot-rolled, 17⅝c.; wire, f.o.b. mill, 9½c.

LEAD SHEETS — Per lb., full rolled, 7¼c.; clipped, 7½c.

MONEL METAL—Per lb., sheets, full finished, 42c.; strip, cold-rolled, 45c.; rods, hot-rolled, 35c.

MUNTZ METAL—Per lb., rods, 14⅝c.; plates, 17½c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

NICKEL SILVER — Per lb., sheets, 10 per cent, 22¾@23⅜c.; 18 per cent, 26½@26⅝c. Wire and rods, 10 per cent, 26½c.; 15 per cent, 30½c.; 18 per cent, 33¾c.

PHOSPHOR BRONZE—Per lb., sheets and rods, 5 per cent tin, 28⅞c.; wire, 5 per cent, 29⅜c.; 10 per cent, 33⅞c.

ZINC SHEETS—Per lb., 9c., f.o.b. works; ribbon 8½c.; 7 per cent discount on orders for 18 tons or more.

Iron, Steel, and Coke

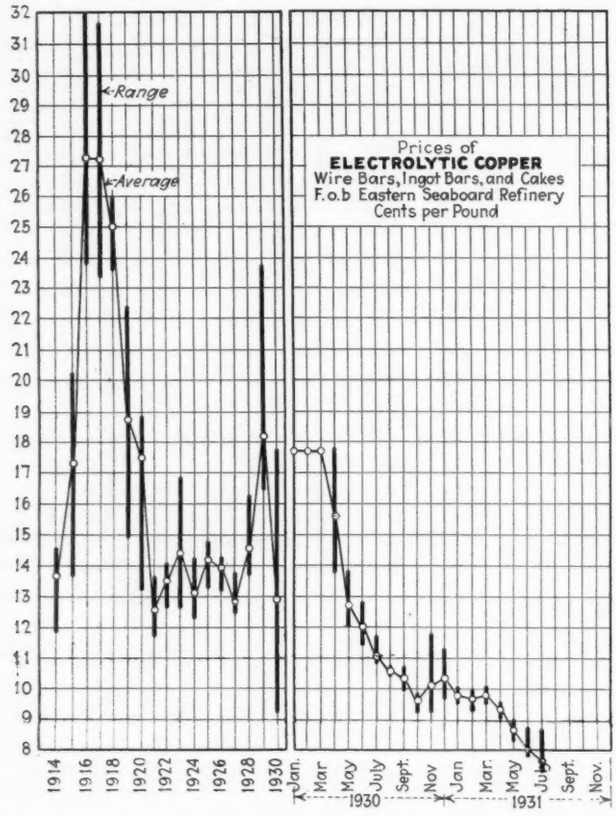
IRON—Per gross ton, Valley furnaces: Bessemer, $17; basic, $17; and No. 2 foundry, $17.

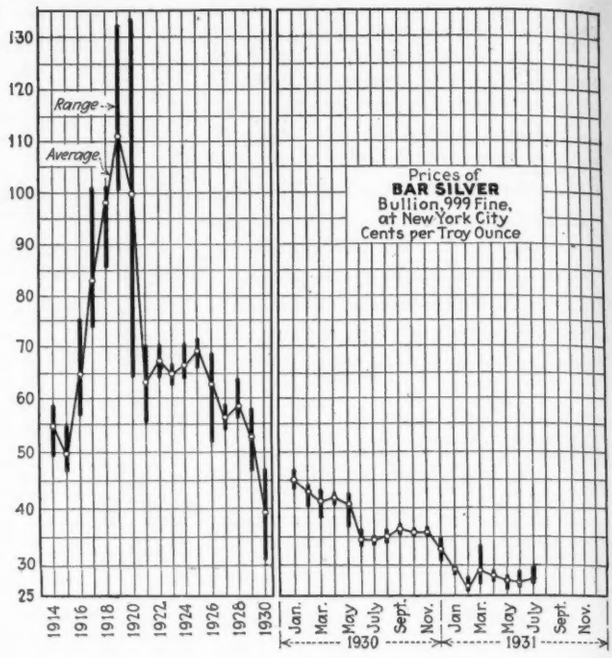
STEEL—Per gross ton, base prices, Pittsburgh, billets and slabs, $29; bars, plates, and structural shapes, per 100 lb., $1.60.

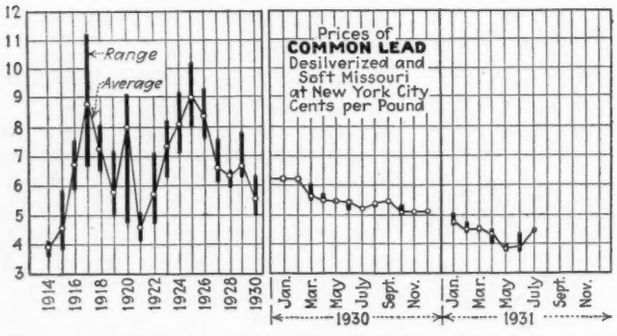
COKE—Per ton, Connellsville furnace, $2.40@$2.50. Connellsville foundry, $3.25@$4.50. Birmingham foundry, $3.50@$4.50. Byproduct coke, Ohio and Kentucky (Connellsville basis), $5.50; Buffalo and Detroit, $8@$8.50; Birmingham foundry, $5.

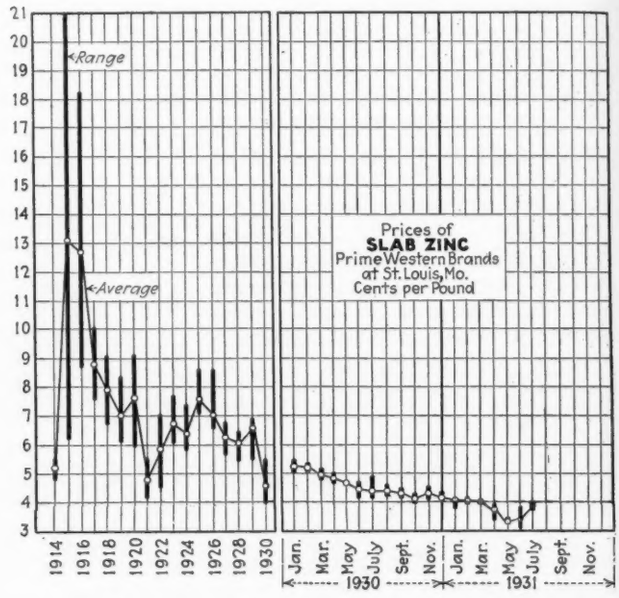
[1]Price furnished by Foote Mineral Company, Philadelphia.

Metal Price and Production Curves

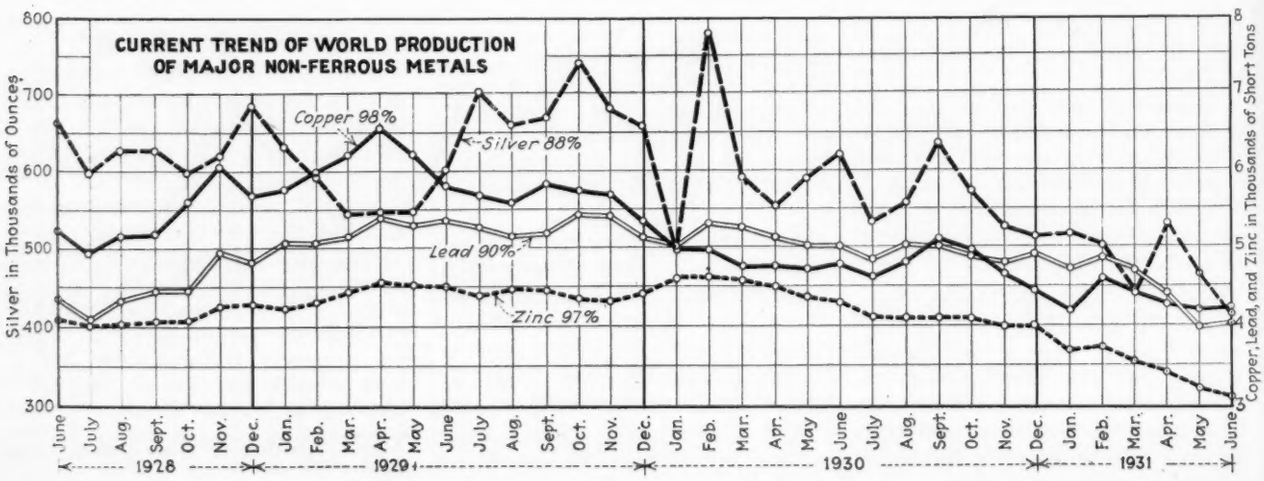








The curves below are not to be considered as permanent records of production. They show merely the current trend in terms of daly output, according to the latest estimates of the American Bureau of Metal Statistics.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Copper 98%
Silver 88%
Lead 90%
Zinc 97%
Silver in Thousands of Ounces
Copper, Lead, and Zinc in Thousands of Short Tons
June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June
1928
1929
1930
1931